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AN EVALUATION OF A DENTURE DUPLICATION PROCESS

by

© Wm. M. Cathro, L.D.S., D.D.S.

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled An Evaluation of a Denture Duplication Process submitted by William Middleton Cathro in partial fulfillment of the requirements for the degree of Master of Science.

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INTRODUCTION

Many patients have a fear of losing their denture, or of the necessity of being without it for a period of time while it is being repaired or relined. Some of these patients ask their dentist to provide them with a second or duplicate denture to avoid the embarrassment of being without teeth. Most patients have difficulty in adapting to second dentures where the occlusion and polished surfaces are different with reference to the first.[50] If a spare denture is to be of value to a patient, it is important that it be a duplicate of the first denture.

In the past years, this problem of trying to copy a denture has given dentists a difficult task. Several methods of copying dentures have been suggested,[27,50,51] one of which[50] entails the setting up of teeth on an articulator, after some method has been used to record the occlusion with reference to the old dentures. Some of the difficulties with these methods, are the result of the instability of the acrylic resin under varying conditions of temperature, thickness and water sorption. Other difficulties may be due to the strains built into the acrylic resin base, by the pressures resulting from compressing the unpolymerised acrylic resin in a confined space, between the plaster cast and the matrix of the denture, and the subsequent release of these strains when the processed denture is re-

moved from the cast.[43] Winkler and O'Connor[1] describe a method of denture duplication with the use of reversible hydrocolloid and a pour type of acrylic resin*. No stone or plaster cast is used. It is this technique which interests the investigator.

The purpose of this study, is to determine the accuracy of this method. In this regard, duplicated maxillary dentures are appraised against a standard master denture, specifically to determine:

1. What changes there may be in the vertical occlusal relation.
2. What changes there may be in the buccal molar width and buccal flange width.
3. What changes there may be in the shapes of the posterior palatal vaults of five duplicated dentures.

Readings will be recorded immediately after processing, after 24 hours water immersion and after a prolonged period in water.

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*Pronto II, Vernon Benshoff Co. Albany, N.Y.

REVIEW OF THE LITERATURE

Several investigators have evaluated the degree of accuracy achieved when constructing dentures by the fluid resin or pour technique.

Goodkind and Schulte[28] found, that upper denture bases produced by the fluid resin technique, shrink. They noted contractions across the buccal flanges of 0.20%. In the areas corresponding to the second upper molars the percentage contraction was 0.11%. Fairchild's[31] experiments showed a contraction of 0.12% across the buccal flanges when making base plates. The fluid resin technique was used with an autopolymerizing acrylic styrene co-polymer denture base material. When an autopolymerizing, cross linked methyl methacrylate denture base material was used, the contraction was 0.08%. In these experiments,[28,31] no teeth were present on the denture bases. Skinner[26] observed, in every instance, that the curing shrinkage is greater on denture bases with teeth than the contraction obtained on denture bases without teeth. Other investigators[2] found an average molar to molar shrinkage on upper dentures after removal from the casts, of 0.3%. The resin used was PRONTO II. The range of processing shrinkage was from 0.1% to 1.0%. Grant and Atkinson[48] in comparing flange to flange measurements across dentures immediately after processing, when compared to the waxed up dentures, found contractions of 1.0 ± 0.4% for dentures processed by the fluid resin technique.

Grant and Atkinson[48] also reported on changes in the vertical occlusal relationships. They notice that most dentures processed by the fluid resin technique showed a vertical dimension decrease. They observed that in some cases there was a continuous variation from positive values on one side to negative values on the other side. Single teeth or groups of teeth showed marked dimensional differences in respect to the adjacent teeth after processing. Some measuring points showed changes in excess of 1.25 mm. Tooth movement in dentures made by the fluid resin technique was unpredictable. On occasion, there was an alteration of the established occlusal plane with contraction of the vertical height on one side of the denture and an increase on the other side. Winkler, Ortman, Morris and Plezia[2] have shown an average decrease in the vertical occlusal height in dentures made of PRONTO II. The anterior teeth showed the least change and the molar cusps the most. An upper denture showed a decrease in vertical dimension of 0.11 mm., 0.2 mm., 0.26 mm. in the anterior teeth, the premolar cusps and the molar cusps respectively. They stated that this loss in both upper and lower dentures combined with selective grinding to perfect the occlusion would reduce the vertical height and that some over-closure will result unless this is compensated for.

They also observed considerable additional shrinkage occurring after processed dentures* are placed in distilled water for 24 hours. Upper dentures shrank another 0.1% linearly after water immersion. Fairchild[31], using base plates, found that after 24 hours water immersion, the contraction was 0.26% between the tuberosities. This compares with 0.08% contraction on the same span before water immersion. An autopolymerizing, cross linked, methyl methacrylate base material was used. Other investigators[47] having processed dentures with the fluid resin technique** showed an average shrinkage between the tuberosities of $0.57 \pm 0.14\%$ after 24 hours in distilled water at $72 \pm 2^{\circ}F$. The same dentures measured after one week in distilled water showed practically no change from the 24 hour readings. After thirty days, measurements indicated an expansion and a return towards the original dimensions of the dentures. The average shrinkage of the dentures then decreased from 0.56% to 0.46%. In other words dentures placed in water showed an initial contraction, followed by an expansion. Sweeney[15] noted that acrylic resin expanded on sorption of water at the rate of 0.23% linearly for a 1% increase in weight of water absorbed. Denture bases placed in distilled water expanded until equilibrium was reached. This was at 1.5% to 2% sorption by weight. This amount of water will cause an expansion

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* Pronto II

** Pour-n-cure

of 0.3% linearly and compensates for about one half of the curing shrinkage of heat cured resins and essentially all the curing shrinkage of self cured denture bases. Sweeney[15] also points out that the cast has a setting expansion of 0.1% to 0.2%, so that clinically cases of heat cured resins are slightly small and self cured resins slightly larger in dimension. Skinner and Phillips[52] observe that polymethyl-methacrylate absorbs water slowly over a period of time. It has been shown that the mechanism is by diffusion of water molecules according to the laws of diffusion. The diffusion co-efficient, D, for a self curing resin is 2.34×10^{-8} per square centimetre, per centimetre per second at 37.4^{o}c. For a typical heat - cured denture acrylic resin, the diffusion coefficient (D) is 1.08×10^{-8} per square centimetre per centimetre per second at 37.4^{o}C. Less then half the value for a self-curing acrylic resin. The diffusion probably occurs between the macromolecules which are forced slightly apart. In this respect the action of water is not unlike that of a plasticiser. One method for the measurement of water sorption is to determine the increase in weight of the resin per unit surface area exposed to the water. Such a method is specified in the American Dental Association Specification #12. According to the specification, the gain in weight by the resin should not be more than 0.7 mgs. per square centimetre. There is no apparent difference between heat cured and self curing resins in this regard. As might be concluded from the low values of the

diffusion coefficient, D, the time required to reach saturation may be considerable. It has been calculated that a typical acrylic resin denture may require a period of 17 days to become fully saturated when immersed in water at room temperature.[52] Because the macromolecules are forced apart by diffusion they are rendered more mobile, with the result that inherent stresses can be relieved with a consequent relaxation and possible change in shape of the denture. Peyton and Mann[14] noted that absorption of water by plastics lowers the tensile strength, the flexial strength, resistance to high temperatures and electrical conductivity.

Plastics[25] continue to absorb water after the 24 hour test period recommended by the American Dental Association Specification #12, and it would be expected that they might continue to change dimensionally as a result of further water sorption. It is suggested that an equilibrium water sorption value[15] might have more meaning than values obtained from the present 24 hour test[25]. Skinner and Jones[26] showed that when various bases were immersed in water at 37°C, equilibrium conditions, so far as dimensional change were concerned, were reached in from 3 to 4 weeks for self curing resins and two weeks for heat curing resins. Peyton[33] found that self curing resins are generally 0.1% oversize after several months of service and that heat cured resins are 0.3% to 0.4% undersized. In comparing dentures constructed with the fluid resin technique* and the self curing technique Goodkind and Schulte[28]

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*Pronto II

found that no significant changes in the dimensional stability of bases made with either technique had occurred after 6 months storage in water. Peyton and Craig[53] also noted that the thickness of the plastic specimen and the types of polymer influence whether equilibrium water sorption[15] will be obtained in 24 hours. The temperature affects the rate at which water is absorbed[53] since the diffusion coefficient is increased by a factor of 2 between room and oral temperature and the equilibrium absorption value does not change. Contrary to this Brauer and Sweeney[40] state that sorption is nearly independent of temperature from $0^{\circ}C$ to $60^{\circ}C$ and that thin specimens reach a steady state of value within a short time period.

Molecular weight also influences water sorption.[40] The lower the molecular weight of the polymer, the higher is the water sorption and diffusion.[40] The higher the molecular weight, the less water sorption occurs. Molecular weights above 500,000 appear to have no further influence on water sorption. The larger internal surface of the low molecular weight polymer will result in an increase in the number of possible water reactive sites within the structure.[40] Brauer and Sweeney[40] have shown that water sorption appears to be independent of the molecular weight in the $4^{\circ}C$ to $37^{\circ}C$ range of temperature. Another investigator[15] has shown that water sorption is independent of molecular weight at all temperatures below $70^{\circ}C$.

The Fluid Resin Technique

Skinner and Phillips[52] note that the rate of polymerization is influenced by the particle size; the smaller the size the more rapid is the polymerization. Shephard[29] states that the polymer of PRONTO II is a very fine, high molecular weight, methyl methacrylate. The fine particle size permits it to pass into and through relatively narrow spaces, while the high molecular weight restricts the initial solubility of the material, so that the viscosity of the liquid phase of the mixture does not increase rapidly during the first few minutes of mixing. The powder has been given a treatment which causes it to fragment into many smaller regular particles after a few minutes exposure to the monomer. This fragmentation solves the problem of maintaining a low viscosity early in the pouring process, while still getting a sufficiently rapid reaction of the monomer and the polymer that the material can be entirely softened to a gel before the curing starts. Sweeney[15] reports that the density of monomer is 0.94 gms. per c.c. and polymer is 1.18 gms. per c.c. and thus a reduction in volume occurs. Fairchild[31] has stated that monomer will shrink 21% in volume during polymerization and therefore a mixture of one part monomer to three parts of polymer will shrink less in processing than will a mixture containing a greater percentage of monomer. Ths usual ratio of monomer to polymer in heat cured and auto polymerizing resins, using the flasking technique, is 1 to 3 by volume. It is important to note that in order to obtain

sufficient fluidity in the initial mix, in the fluid resin technique, a ratio of 1 to 2 is used in the case of the co-polymerizing acrylic resin. It would therefore be expected from this consideration alone, that a denture processed by the fluid resin technique would exhibit greater shrinkage than would those processed by the flasking technique. Atkinson and Grant[48] observed that the contraction of the dough used in the heat curing technique, was 6.6% whereas that for the fluid resins was 10.3% and note that an increase in the polymerization contraction of the fluid resin was to be expected since the fluidity of the mixture is achieved, among other things,[29] by increasing the amount of liquid to powder in the mixture. In using two types of fluid resin, Shephard[29] claims that the better results were obtained with PRONTO II than with POUR CURE. This he attributes to the incorporation of a greater amount of polymer (1 monomer to 2 1/2 polymer) than in the other resin. Skinner and Cooper[12] say that the polymerization shrinkage is possibly compensated for by excess resin in the mould, the relief of strains in the investing medium and other factors. They thought that it would be at this stage, while the plasticity of the resin is relatively great, that the injection moulding process would be theoretically superior to compression moulding, since additional resin supposedly can be forced into the mould to counter-act what is usually called the polymerization shrinkage. Fluid resins are polymerized in an agar mould under pressures of 20 pounds per square inch and at a temperature of 38°C to 40°C. However

Atkinson and Grant[48] using thermocouples, claim that the internal temperature can reach as high as 80°C during polymerization. If this be true, it is conceivable that there is considerable thermal contraction during cooling.

The Flasking Technique

In studying heat processed dentures, Osborne[43] observed that, quite apart from polymerization shrinkage,[12] strain is set up in dentures after polymerization. This occurs during the time that the resin is cooling from the polymerization temperature to room temperature, in other words, by the thermal contraction of the acrylic. Sweeney[15] points out that heat cured resins probably conform to the mould at high temperatures and that the effective shrinkage is the thermal contraction of the resin from the temperature at which it is sufficiently elastic to resist distortion, down to room temperature. He gives the example that, if this elastic temperature of the resin is 75°C (167°F), and the denture is cooled to room temperature of 20°C (68°F) in the flask, and the coefficient of contraction of the resin is 80×10^{-6}, then the contraction through this temperature range, 55°C, is 0.44%. Osborne[43] observed the considerably different coefficients of expansion (contraction) of acrylic resin and plaster. The resin base contracted more than four times as much as the plaster mould. Thus at room the resin was bound to be strained, since the dimensional changes have not

been able to take place at will, due to the restraining influence of the mould. He[43] also said that the strain would be released as soon as the resin was removed from the flask. Osborne[43] also observed that as long as plaster is used for the flasking material, it would be difficult to see how this thermal contraction strain could be eliminated.

Grunewald, Paffenbarger and Dickson[16] also found that stress would be expected to occur in a denture because of the difference in the coefficient of expansion and contraction of methyl methacrylate and plaster. Greater stresses are placed on a denture using the compression moulding technique than the fluid resin technique. This is because of the greater thermal contraction due to higher processing temperatures and the confinement of the resin in a rigid plaster mould, as compared to an agar mould used in the fluid resin technique, and the different coefficients of expansion of plaster and methyl methacrylate. Woefel, Paffenbarger and Sweeney[4] note that the changes after flasking and curing are small compared with the changes when the dentures were removed from the cast. Winkler, Ortman, Morris and Plezia[2] also noted that the release of stress accounted for the contraction of cured dentures on separation from the casts. Because of the shape of the completed dentures this contraction takes place primarily in the posterior region. Roydhouse[7], talking of cold curing resins, states that no heat is required for polymerization and that no cooling contraction has occurred and therefore the mould has contained only the polymerization shrinkage. Mowery, Burns, Dickson, and Sweeney[41] found that the average processing shrinkage of

self cured resins was less than that of heat cured resins, presumably because the polymerization temperatures of the self curing materials would tend to give less thermal contraction after polymerization. Skinner and Jones[26] noted that dentures processed in cold cure at $37^{\circ}C$ exhibited a greater curing shrinkage than those processed at room temperature ($20^{\circ}C$ - $25^{\circ}C$).

Measuring Temperatures

The high coefficient of thermal expansion (contraction) of resins should be taken into account when evaluating data obtained by measurements made at room temperature. ($72^{\circ} \pm 2^{\circ}F$ $23^{\circ}C \pm 2^{\circ}C$) Winkler, Ortman, Morris and Plezia[2] say that measurements made at mouth temperature, $37^{\circ}C$, show 0.14% less shrinkage than measurements made at room temperature. Woefel, Paffenbarger and Sweeney[36] point out the necessity of making corrections on measurements made at room temperature, because dentures function at mouth temperatures. A correction for the thermal expansion of acrylic resins over this $14^{\circ}C$ range must be made ($37^{\circ}C$ - $25^{\circ}C$) Woefel, Paffenbarger and Sweeney[4] would expect an increase on all measurements, of 0.12%, made at room temperature.

Effects of Size, Shape and Thickness

Differences in processing shrinkages among individual dentures of the same material are caused by variation in the size, shape and

thickness of the denture. Thickness is especially important, because it governs the stiffness, thus limiting the degree of contraction of the denture.[36] Skinner and Phillips[52] consider another factor. The ridge portion of the maxillary denture base is thicker than the palatal area. During the polymerization shrinkage, the resin will tend to shrink toward the bulkier ridge portions and the palate will thus be subject to tensile stress. Winkler, Morris, Ortman, and Plezia[2] noted that the average molar to molar shrinkage of thin dentures of all materials, is approximately twice that of thick dentures. Laundry[44] noted that one of the factors influencing the dimensional stability of a denture base, was the presence of teeth, and the varying resin thickness throughout a denture. Osborne[43] found that the degree of strain is reduced when a restoration has curvatures in only one plane, and that strain is absent in flat specimens, due to the spontaneous relief after deflasking. Woefel, Paffenbarger and Sweeney[5] found that a thinning procedure of dentures doubles the shrinkage which occurs when the dentures are removed from their casts. Generally the flange to flange shrinkage[5] in upper dentures was greater proportionally than the molar to molar shrinkage when the denture was removed from the cast.

Methodology Review

Osborne[43] detected the strains formed in dentures by processing in three ways. Firstly the denture was subjected to increase in

temperature by immersion in water and the degree of warpage was noted relative to a metal mould on which the denture was constructed. Secondly a solvent was used to produce a crazing effect in the areas of greatest strain using a clear resin. Strain was observed in the third instance by sectioning dentures and observing them in polarized light. These strains are concentrated in areas of inserts having different coefficients of contraction from acrylic resin, such as porcelain teeth and metal clasps[43]. Strains are also found in the thinner palate region because the acrylic resin shrinks towards the thicker ridge portion of the denture base[52]. Sweeney, Paffenbarger and Beall[15] investigated the effect of water on dentures by weighing, desiccating, wetting and drying. Gauge reference marks placed on each denture, just posterior to the last teeth were used to measure dimensional change with a micrometer microscope. Sweeney[11] packed samples of denture base material in a metal block of known dimensions to determine the linear shrinkage of denture base materials.

Woefel, Paffenbarger and Sweeney[4] measured vertical discrepancies by means of a dial gauge and a Hanau articulator. The same investigators[4] sectioned gypsum moulds on which dentures were processed to observe the adaptation of the acrylic. Sweeney, Paffenbarger and Beall[13] detected the curing shrinkage of dentures by using a stainless steel die which simulated the upper arch form. Two reference points were cut on the crest of the ridge portion of the die. The cases were waxed up

and processed on the die. The apparent linear shrinkage was evaluated from measurements of the distance, between the two reference marks on the metal die, and the corresponding marks on the resin, which were transferred to it during processing. Many researchers used such reference points in a like manner. Winkler, Morris and Thongthammachat[47] used highly polished stainless steel pins as their reference points. These pins were cemented, flush with the top surfaces, in the second molar regions, of maxillary casts. Indentations were made on the pins with a Rockwell Brale Diamond Penetrator. A calibrated microscope was used to measure the linear dimensional change. Assessment of changes in the vertical occlusal relationship was achieved with a dial gauge and brass measuring rod attached to the cross arm of a Ney Surveyor. The vertical height of all teeth was measured after the completed waxed denture was luted to the gypsum cast immediately before processing. The vertical height was measured again after the dentures were processed and separated from the investing material, but on their respective casts. Grant and Atkinson[48] also used casts with reference points so that the marks would be transferred to the completed denture. Three vertically adjustable supports, on a surface plate, were used to position the waxed up denture and the cast after processing. Comparative measurements of the height of each tooth were made with a brass rod and a dial gauge. Woelfel, Paffenbarger and Sweeney[36, 4,] measured the increase in height of the incisal pin on a Hanau articulator to determine the vertical

changes in occlusal relation. Skinner and Jones[26] used a master model cast in aluminium with no undercuts. Gauge marks were cut in the cast. A Korogel mould was made of the model for the construction of duplicate casts with Duroc. The distances between the gauge marks were carefully measured on the cast and compared with the distances between their impressions in the denture bases. Mowery, Burns and Dickson[9] used stainless steel reference points in the last molar and buccal peripheral flanges. Measurements were made with a tool makers microscope. Goodkind, and Schulte[28] used an Invar metal steel die. The steel die and casts were measured under magnification with a Nickon Optical Comparator. Paffenbarger and Dickson[11] used stainless steel dies with reference points. McCracken[46] used machined threaded studs as his reference points. Rupp, Dickson, Lawson and Sweeney[10] described a method for measuring the mucosal surface contours of casts, impressions and dentures. Fairhurst and Ryge[35] used the Contour Meter. The accuracy of fit of dentures was determined by Anthony and Peyton[38] using a Modified Comparator, first described by Rupp.[10]

The Agar Investing Medium

Winkler[3] used reversible hydrocolloid as the investing medium when describing a fluid resin technique for processing dentures. A modification of this method was suggested by Winkler and O'Connor[1] as a method of duplicating dentures. It is advised that the temperature

of the reversible hydrocolloid should not be brought above 135°F - 140°F because too high a temperature will make it difficult to position the wax pattern.

A comparison was made between alginate, and reversible hydrocolloid as an investing medium for the fluid resin technique by Winkler, Morris, and Thongthammachat.[47] Shephard,[29] when using a reversible hydrocolloid* and a special flask, noted that some shifting of the teeth may occur where there has been excessive grinding. When this has been necessary, the hydrocolloid does not grip the teeth adequately. It was also stated by Shephard[29] that the glycerol or glycol type of hydrocolloid had given better results than the aqueous type. It was suggested by Atkinson and Grant,[48] that the cast may tilt within the agar mould. They consider that a combination of the nature of the investing material along with the greater polymerization contraction of the fluid resin, to be responsible for the greater tooth movement compared to heat processed methods. Applegate[21] considers that the best temperature for hydrocolloid solution is 130°F, while Peyton and Craig[53] have stated, that when exposed to air, agar hydrocolloid loses moisture and shrinks. Duplicating hydrocolloids must comply with the American Dental Association Specification #20 in that permanent deformation shall not be more than 3% when tested as described 4.3.9.3. A.D.A.

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*Perflex (Howmet Corp.) Chicago 3

Phillips and Skinner[52] state that the stiffness and strength of the gel is directly related to the brush heap density concentration. In a letter of personal communication to the investigator from How Medica Dental Division, regarding the dimensional accuracy of reversible hydrocolloid, "Perflex", it was indicated that no figures were available relating to expansion and contraction characteristics.

Methodology

A master denture and a master cast were used in the method selected to study what dimensional changes[1,2,28,29,31,] might occur in the duplication process suggested by Winkler and O'Connor.[1] It was imperative that, over the period of time required for the experiments, both the master denture and master cast be relatively stable. It was decided to cast both in metal.*

The Construction of the Master Cast and Master Denture

A maxillary stone cast, free of undercuts was selected. The base was made absolutely flat.[2,47] A slot was drilled into this cast in the mid-line, extending from the posterior border of the cast, one centimetre anteriorly. The total width of the slot was four millimetres, two millimetres being on each side of the mid-line.

An impression was made of this cast in duplicating hydrocolloid** and a refractory cast was poured.*** Casting wax was adapted to this cast to form a layer over the entire denture bearing area. The wax was also extended downwards towards the base to cover the walls of the slot. The pattern was cast, and thus a metal skin

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* Ticonium

** Ticonium special duplicating colloid

*** Ticonium investic model investment

was formed corresponding in shape to the denture bearing area and slot of the original stone cast. A metal strip 3 mm. wide and 0.5 mm. in thickness was made to cross the slot in a lateral direction. This was soldered into position on the base side of the slot. The strip was made parallel to the posterior border of the metal casting. The posterior border of the metal strip was placed 4 mm. anterior to this. After polishing the metal work, an acrylic resin base was added to complete the master cast (Fig. 1), which was free of undercuts. The strip of metal at the base of the slot was to serve as a measuring reference point.

The master denture was fabricated in the following way. An impression was made of the master cast in a duplicating hydrocoll-oid and a refractory cast was poured. Casting wax was adapted to the denture bearing area of the refractory cast to form the pattern of the denture base. The pattern wax was formed above the slot. The shape of the wax base in this area was made to conform to what would have been the normal shape of the palatal vault. Suitable retention mesh was incorporated in the wax denture base along the crest of the ridge. Their purpose was to retain the teeth at a later stage of the procedure. The wax pattern of the palatal vault was made to be of 1.5 mm. thickness. The metal base was now cast, polished and fitted the master cast.

Fig. 1 Master Cast

Acrylic resin teeth were used. The posterior teeth had 33° cusps. Before setting up the teeth, however, the right central incisor, the right first bicuspid and both right and left molars were altered in form and then cast in metal. In the first instance, "flats" were ground on their labial and buccal surfaces. These "flats" were to be used as measuring points. Guide facets for a specifically adjusted calliper were also cut in the incisal edge of the incisor and the occlusal surfaces of the bicuspid and molars. Steel's type backings in acrylic resin were luted to the buccal gingival aspects of the second molars to provide buccal flats as reference points. Metal castings of these prepared teeth and backings were completed and were then soldered in their appropriate positions on to the metal base plate. These "flats" and facets were now refined by milling and machining. In addition, on the ridge surface of the denture base, small dimples or hollows were drilled above the area of the right central incisor, the right first bicuspid and the right second molar. These were to be measuring reference points for a specifically adjusted calliper. The remaining teeth were then set up in wax on a flat occlusal plane. A heat cure acrylic resin was employed to secure the teeth to the denture base. It was assumed that the metal portions of the denture would be stable. (Fig. 2)

The Duplication Technique

A laboratory was set up with the necessary equipment and

Fig. 2 Master Denture

supplies for the duplication of dentures based on the technique described by Winkler and O'Connor.[1] This involved investing the master denture in a standard denture flask with hydrocolloid. The investigator modified the technique in one way. It was found that the weight of the metal master denture caused it to sink when lowered into the hydrocolloid.[10] This was overcome by making a wire frame to support the denture during the gelation process. This consisted of two pieces of wire soldered in the form of a cross. The arms were supported by the periphery of the flask. A small portion of compound was used to attach the solder joint to the palatal surface of the master denture. This maintained its position in the hydrocolloid while gelation took place. When the hydrocolloid had cooled and gelled, the compound and the wire support were freed from the master denture. A pouring sprue was located from the centre of the ejector hole to the centre of the palate. Venting sprues connected the ejector hole to the highest points of the buccal and labial flanges. Fifteen duplicate dentures were made in this manner.[1] (Fig. 3)

The Method of Measurement

The method of measurement utilizes two different specifically adjusted callipers and the reference points which are the "flats", facets and dimples on the master denture. A dial calliper gauge, (Fig. 4) reading to 0.005 mm. was used for the linear measurements, which were the flange to flange distance and the molar to

Fig. 3 Duplicate Denture

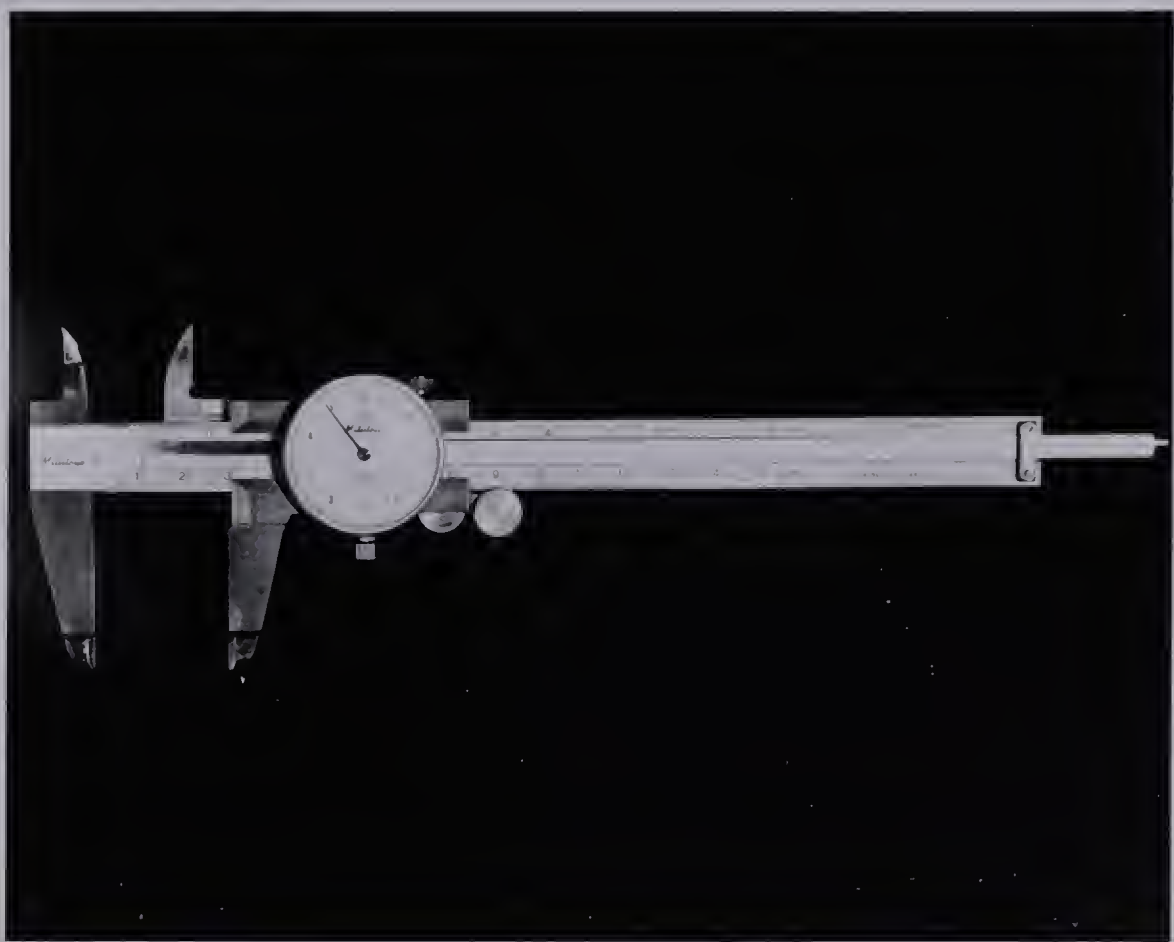

Fig. 4 Dial Calliper Gauge Used For Linear Measurements

molar distance. The blades of this calliper were machined to fit the "flats".

Another calliper (Fig. 5) was altered by the addition of a metal rod which was machined to mate with the dimples drilled in the ridge surface of the master denture. The other arm of the calliper fitted the occlusal and incisal facets. These two callipers were used for the linear and vertical occlusal measuring of fifteen duplicate dentures. In using the callipers, firm pressure had to be applied between the blades and the reference points on the dentures to obtain accurate measurements.

A contour gauge was also made (Fig. 6). Movable metal rods of 1 mm. diameter could be adjusted to fit the palatal vault, the dimples above the second molars and the buccal flange "flats". After positioning the metal contour rods could be locked by tightening the two wing nuts.

These contour patterns of the cross section of the master denture and duplicates were photographed in silhouette. A constant focal distance and a millimetre scale were used to ensure uniform enlargement of the negatives. Enlarged prints were made and tracings were made from these. Contour transparency tracings of the duplicated dentures were then superimposed upon those of the master denture. Reference points used for the superimpositions, were the highest points on the crests of the maxillary ridges, which were the dimples on the dentures. In making the superimposition drawings, these points were made to coincide. Five superimposition drawings were made of

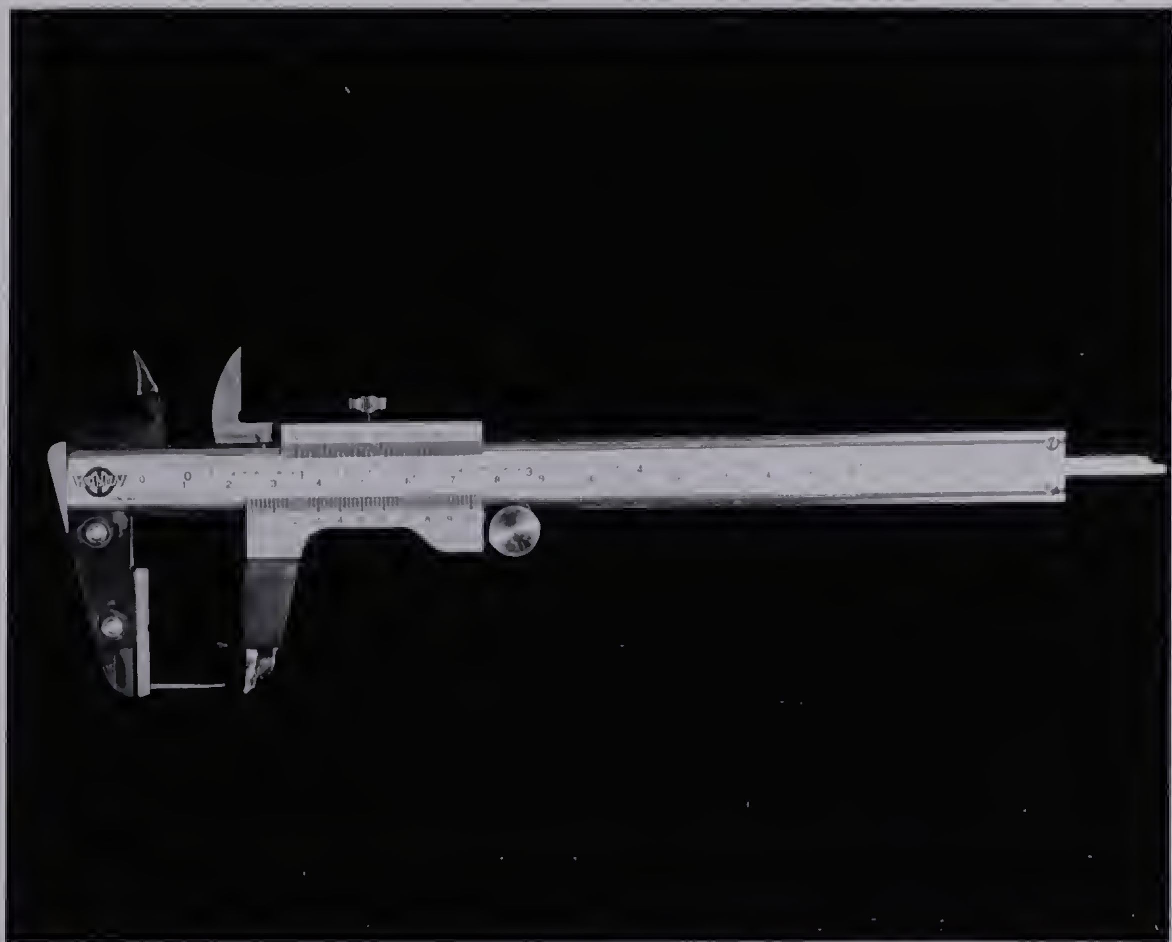

Fig. 5 Calliper Used For Vertical Occlusal Measurements

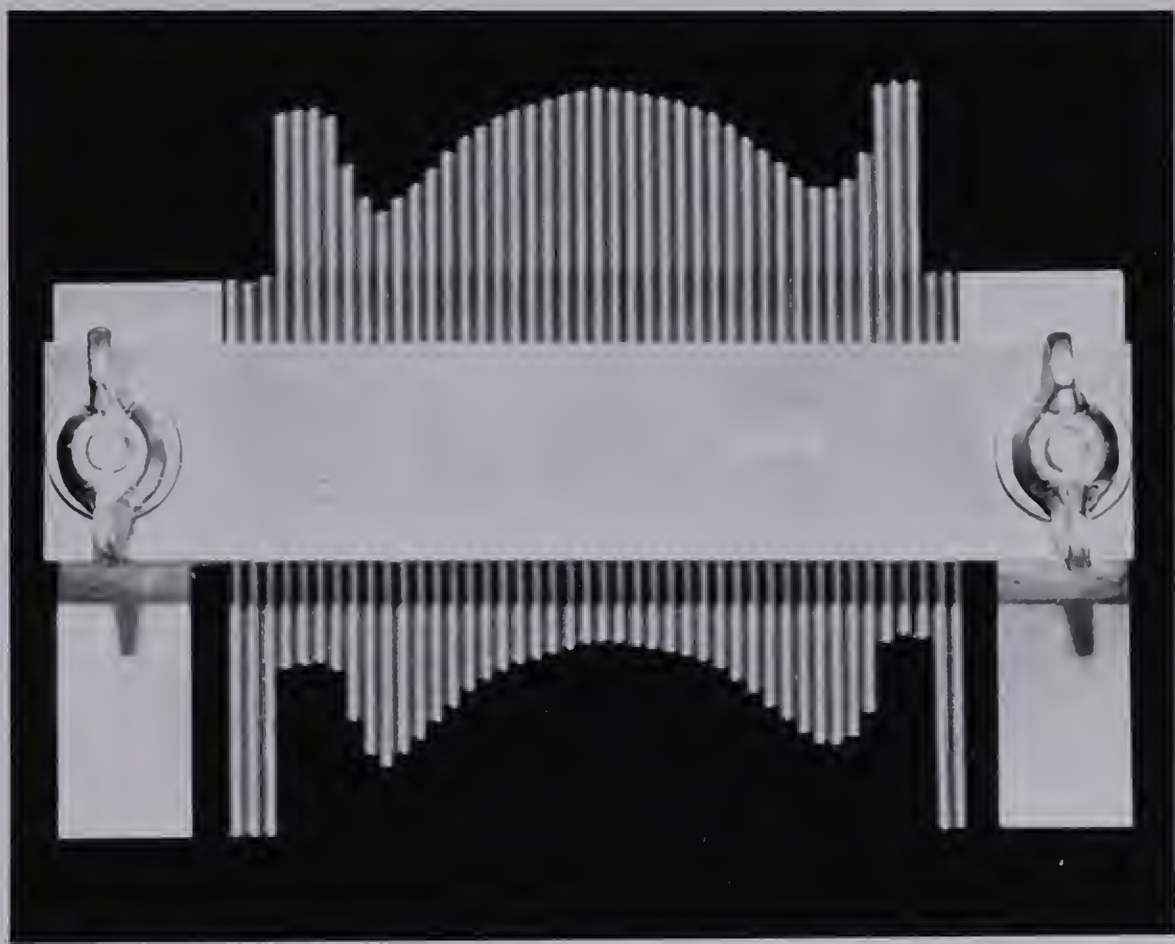

Fig. 6 Contour Gauge With Movable Metal Rods

the master denture and the duplicated dentures after they had been immersed in water at body temperature, 37°C, for four months. As a control check on the accuracy of this technique, five further contour patterns of the master denture were made and each of these was photographed. Transparency tracings, made from these, were compared with the original master denture contour tracing to determine if there was any variance.

The method[2,47,48] of measuring changes in the vertical occlusal relationship by means of a brass rod machined to fit a dial gauge, fitted to the cross arm of a Ney Surveyor, was abandoned. The duplicated dentures would not return with accuracy to the master metal cast and thus the readings were valueless. The slot on the master cast, with its reference point, could not be used with the dial gauge to measure palatal discrepancies.

A tissue culture cabinet* (Fig. 7) was adjusted to maintain a constant temperature of 37°C. Immediately after processing, each duplicate denture was measured at 37°C in the constant temperature chamber. Fifteen readings were taken for each dimension. The master denture was kept in the tissue cabinet at 37°C during the period of the experiment. Each time a duplicate denture was constructed, a check was made on the stability of the master denture. A check on the accuracy of the measurement of the master denture was made by members of the Prosthetic staff.

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* Prior Co.

Fig. 7 Constant Temperature Cabinet

The duplicated dentures were stored in water for twenty-four hours at 37°C in sealed beakers to prevent evaporation and were then measured again. After water immersion for four months at 37°C the contour photographs were taken of the duplicate dentures and further measurements made.

The Results

The Master Denture

The master denture was measured extensively, (over 225 times on each of the dimensions considered) so that the accuracy of the measurements would permit the resulting five Means to be treated as parametric values. The statistical results are summarised in Table I.

The Buccal Flange Width

The average change across the buccal flange width in the duplicated dentures, was -0.633 mm. (σ.1734). The percentage contraction was -1.08. After 24 hours water immersion there was a slight recovery. The average contraction across the buccal flange width was -0.587 mm. (σ .1744), or 1%. More than 99% of all dentures processed by this technique would be significantly less than the master denture value of 58.764 mm. immediately after processing and after 24 hours water immersion. The 4 month measurements show expansion relative to the 24 hour readings. The average contraction across the buccal flange width was -0.430 mm. (σ .1671) or -0.73% compared to the master denture. Never the less still more than 99% of all dentures produced by this process would be less than the master denture in this dimension after 4 months water immersion.

The Buccal Molar Width

The buccal molar width also showed contraction in the duplicate dentures. The average change was -0.673 mm. (σ .1186) or 1.25%. After 24 hours water immersion there was some recovery. The average contraction was -0.575 mm. (σ .1054) or 1.07% relative to the master denture. More than 99% of all dentures processed in this manner would have this dimension significantly less than the master denture value of 53.907 mm. immediately after processing and after 24 hours water immersion. After 4 months water immersion the buccal molar width contraction was reduced to -0.426 (σ .1123) or 0.79%. More than 99% of dentures made in this manner would show some contraction relative to the master denture, across the buccal molar width, after 4 months water immersion.

The Vertical Occlusal Height in the Molar Region

The changes in the vertical occlusal height were variable. In 77% of cases processed there would be an increase of vertical height in the molar area. The average increase in vertical occlusal height was 0.211 mm. (σ .2828) or 3.66%. After water immersion for 24 hours 83% of dentures would show an increase in vertical height of .065 mm. The average increase in vertical height relative to the master was 0.276 mm. (σ .2851) or4.79%. The 4 month readings showed a loss of

vertical height when compared with the 24 hour readings. The increase of vertical height compared to the master denture was .205 mm. (σ .3026) or 3.56%, which would occur in 75.1% of cases.

The Vertical Occlusal Height in the Bicuspid Region

The average change of vertical height in the bicuspid region was -0.180 mm. (σ .1599) or 3.56% contraction. This loss of vertical height would be of such a nature that more than 87% of dentures produced by this process would show measurements below the master denture value of 5.048 mm. After 24 hours the same number of cases, (88%) show values below the master denture measurement. The average contraction for all duplicates in the bicuspid region after 24 hours in water was -0.208 mm. (σ .1735). The contraction observed in the bicuspid region after 4 months water immersion was -0.108 mm. (σ .1992). 70.5% of cases would be less than the master denture value of 5.148 mm. after 4 months in water.

Vertical Occlusion Height in the Incisor Region

The central incisor showed an increased vertical height of 1.56%. The average increase of vertical height was 0.095 mm. (σ .2539) immediately after processing. Compared to these results, there was a slight loss of vertical occlusal height in the incisor region after 24 hours water immersion. The average change in vertical height re-

lative to the master denture was +0.007 mm. (σ .1225). After 4 months water immersion a contraction was observed in the vertical height of the incisor compared with the master denture.

The results are complex and a summary is given. Duplicate dentures show contraction across the buccal flange width and buccal molar width immediately after processing. Different readings are obtained after 24 hours water immersion and yet again after 4 months in water. After 24 hours, the flange to flange and molar to molar distances show a slight expansion towards the original denture shape, and after 4 months over one third of the contraction observed immediately after processing has been regained.

Immediately after processing, most often there would be an increase in vertical height of the molar teeth and also of the incisor teeth, but to a lesser degree. Usually there would be a decrease in vertical height of the bucuspid teeth. The vertical occlusal changes after 24 hours water immersion are more complex. The molars continue to gain in vertical height, while both the bicuspid and incisor teeth contract. After 4 months in water, the vertical height of the molars are almost the same readings as observed immediately after processing the denture and the bicuspids has regained almost one half of their original contraction. The incisors now show a very slight loss of vertical height compared with the master denture. The linear dimensional

changes can be correlated with the vertical occlusal changes. (Table II)

There was minimal change in the shape of the posterior palatal vault after 4 months water immersion. The contour gauge tracings of the palate showed a maximum contraction in the palatal suture area of 0.5 mm. and a variable distortion in the region of the palatine mucous glands of 1 mm. Greatest linear contraction was observed in the region of the buccal flange. (Figs. 8,9,10,11,12) However, the control check of the accuracy of these measurements showed that none of the superimposition tracings of five master contour photographs coincided exactly with the original master tracings. The most accurate superimposition tracing of a master upon the original master drawing (Fig. 13) shows a variance of 0.1 mm. in the region of the palatine mucous glands. The other four control check shows discrepancies of not more than 0.2 mm. in the same regions.

The results obtained from all measurements of the master denture, and the results of all the measurements of each duplicate denture are shown in Tables III to LXII. The statistical results are presented in Table LXIII and Table LXIV.

TABLE I

SUMMARY STATISTICS FOR ALL DUPLICATES

LOCUS OF MEANS

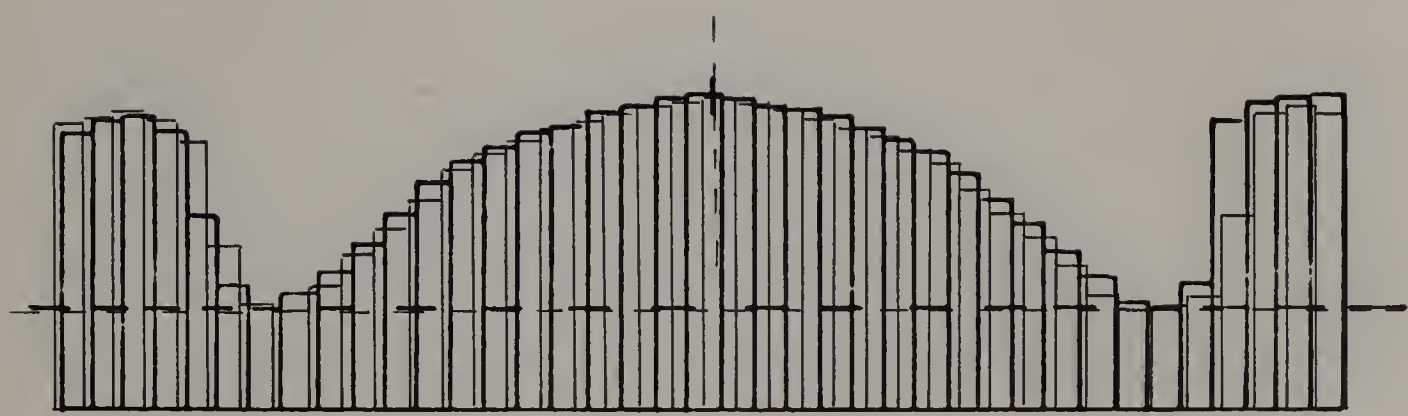
DENTURE STATISTICS		B.F.W.	B.M.W.	V.H.M.	V.H.B.	V.H.I.
MASTER		58.764	53.907	5.763	5.048	6.068
DUP.	$\overline{X}$	58.131	53.234	5.974	4.868	6.163
	σ	.1734	.1186	.2828	.1599	.2539
	U.L.	58.647	53.587	6.816	5.344	6.919
	L.L.	57.615	52.881	5.132	4.392	5.407
	% Change	-1.08	-1.25	3.66	-3.56	1.56
DUP.-24 hrs.	$\overline{X}$	58.177	53.332	6.039	4.840	6.075
	σ	.1744	.1054	.2851	.1735	.1225
	U.L.	58.696	53.646	6.888	5.356	6.440
	L.L.	57.658	53.018	5.190	4.323	5.710
	% Change	-1.00	-1.07	4.79	-4.12	0.12
DUP.-4 mths.	$\overline{X}$	58.334	53.481	5.968	4.940	6.014
	σ	.1671	.1123	.3026	.1992	.0749
	U.L.	58.831	53.815	6.869	5.533	6.237
	L.L.	57.837	53.147	5.067	4.347	5.791
	% Change	-0.73	-0.79	3.56	-2.14	-0.89
DUP.	% below master	99%+	99%+	23%	87%	36%
DUP.-24 hrs.	% below master	99%+	99%+	17%	88%	45%
DUP.-4 mths.	% below master	99%	99%	24%	70%	76%

TABLE II

CORRELATIONS

DENTURE	LOCUS	B.F.W.	B.M.W.	V.H.M.	V.H.B.	V.H.I.
		LOCUS				
DUP.	B.F.W.	---	.352	.124	-.527*	.206
	B.M.W.		---	-.179	-.019	.414
	V.H.M.			---	.068	-.525*
	V.H.B.				---	.068
	V.H.I.					---
DUP.-24 hrs.	B.F.W.	---	.113	.304	-.008	.319
	B.M.W.		---	-.125	-.204	.553*
	V.H.M.			---	.500	.195
	V.H.B.				---	.064
	V.H.I.					---
DUP.-4 mths.	B.F.W.	---	.224	.294	-.389	.135
	B.M.W.		---	-.396	.089	-.040
	V.H.M.			---	.084	.153
	V.H.B.				---	.124
	V.H.I.					---

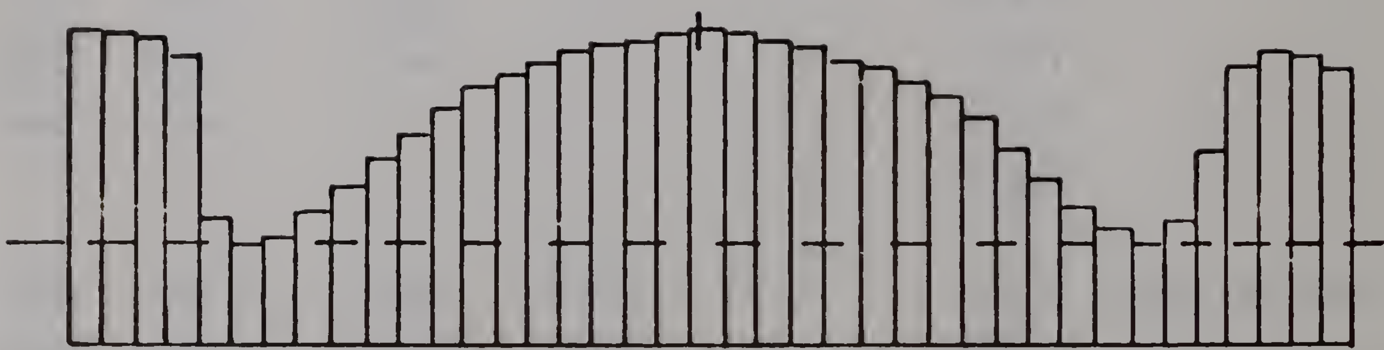
* Referred to in 'Discussion'



Case 11

Contour transparency of duplicate denture after four months water immersion, superimposed on contour pattern of master denture. Scale X 2.

Fig. 8



Case 11

Contour transparency of duplicate denture after four months water immersion, superimposed on contour pattern of master denture. Scale X 2.

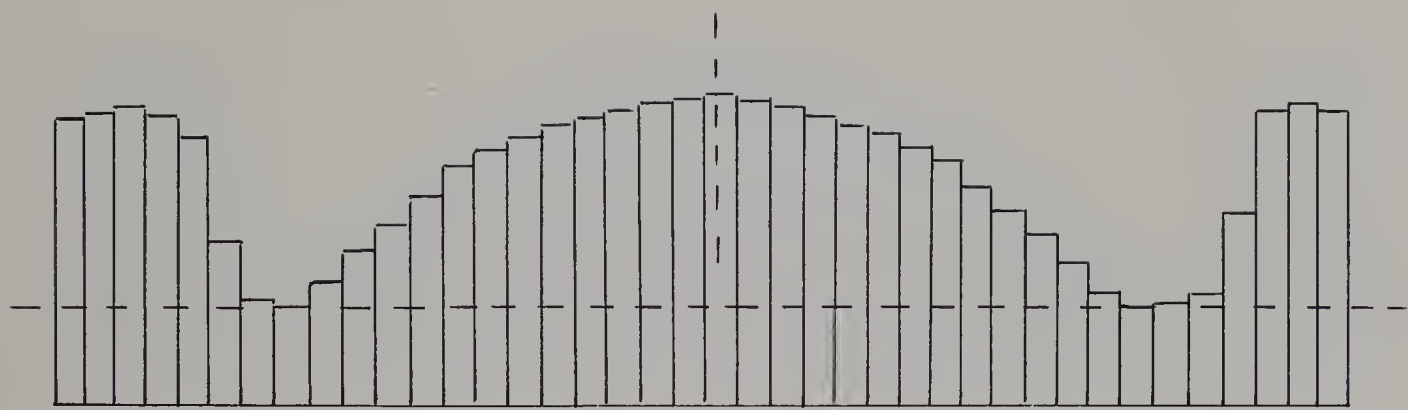
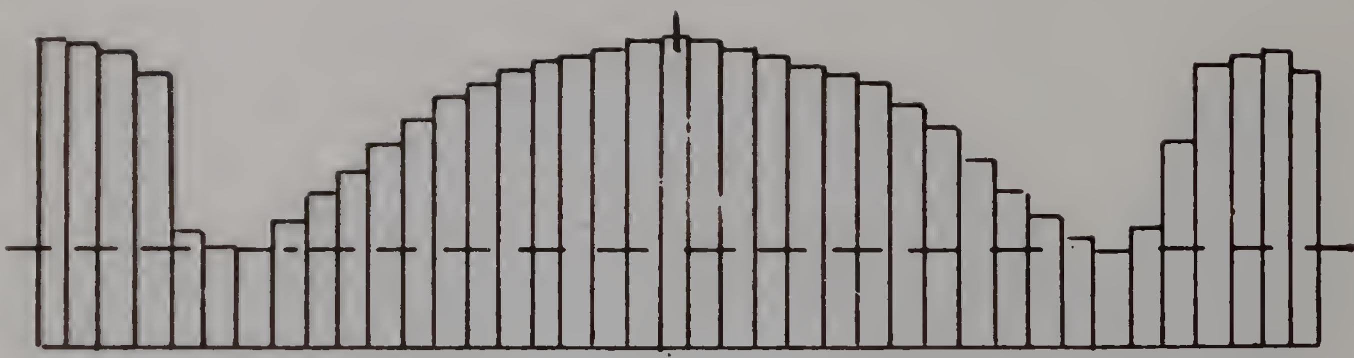


Fig. 8

Case 12

Contour transparency of duplicate denture after four months water immersion, superimposed on contour pattern of master denture. Scale X 2.

Fig. 9



Case 12

Contour transparency of duplicate denture after four months water immersion, superimposed on contour pattern of master denture. Scale X 2.

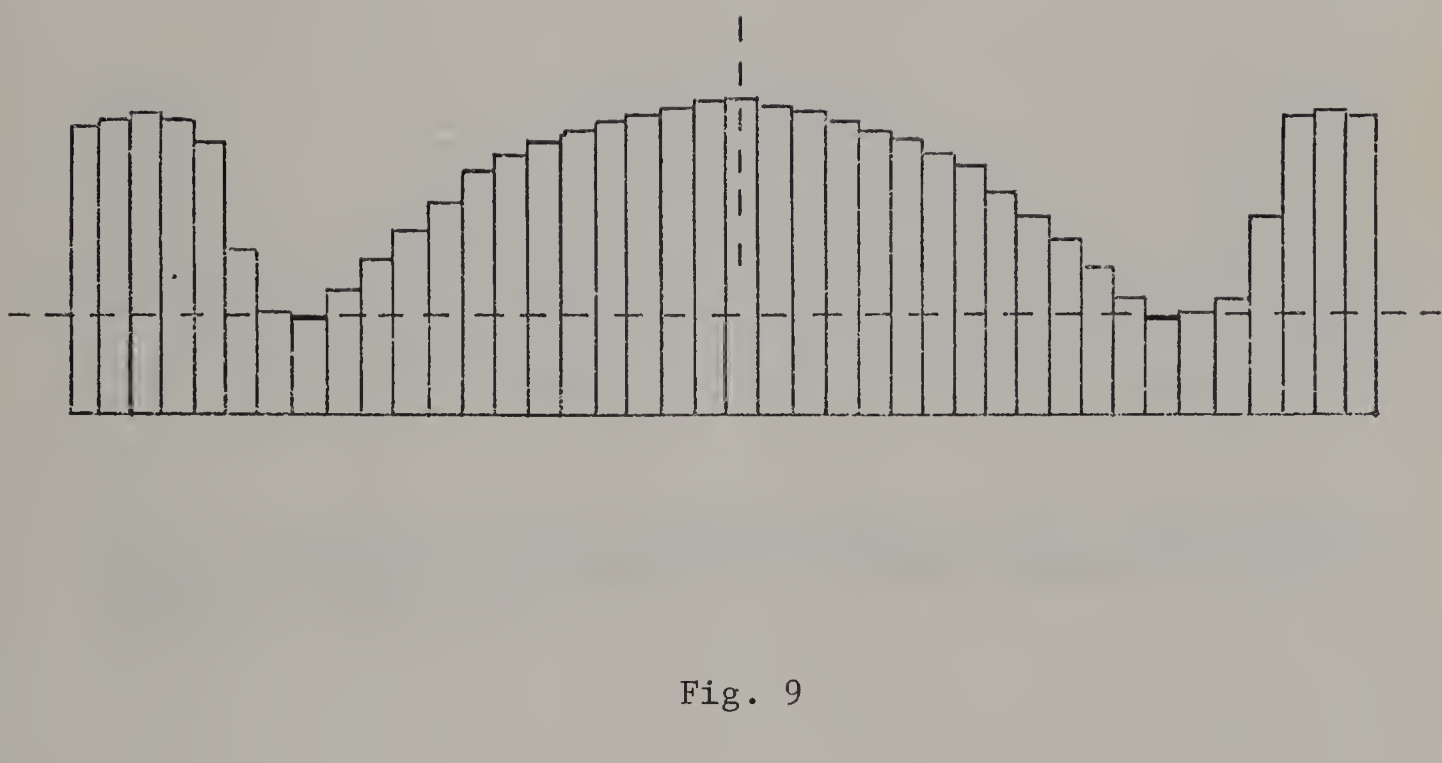
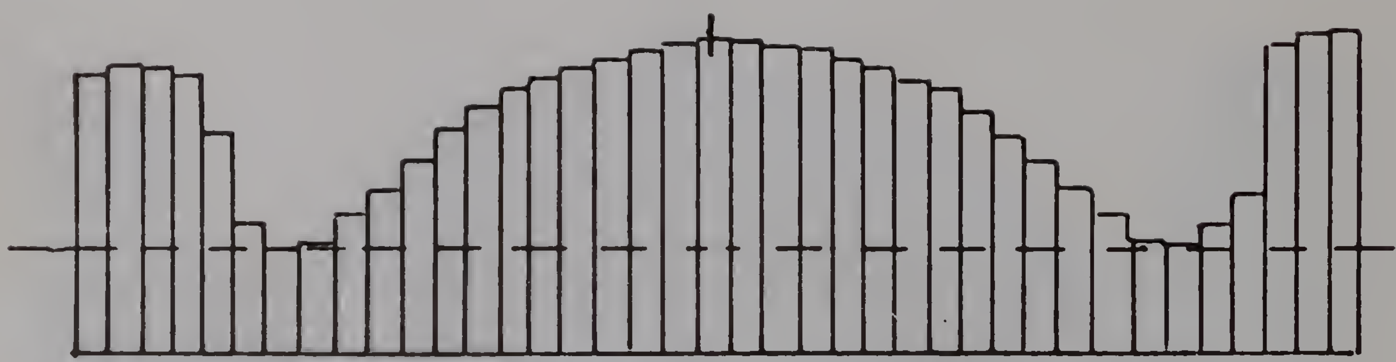


Fig. 9

Case 13

Contour transparency of duplicate denture after four months water immersion, superimposed on contour pattern of master denture. Scale X 2.

Fig. 10



Case 13

Contour transparency of duplicate denture after four months water immersion, superimposed on contour pattern of master denture. Scale X 2.

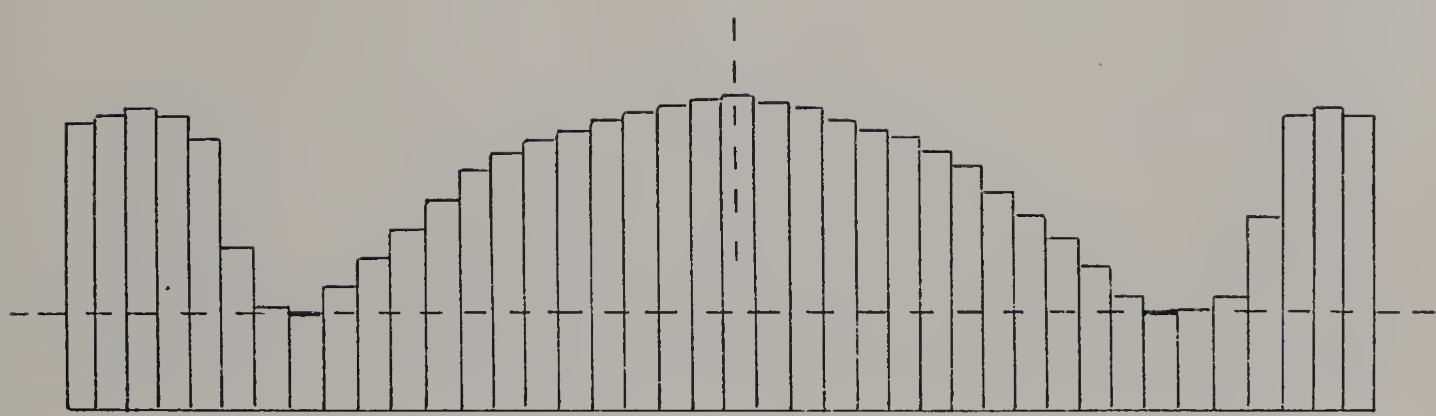
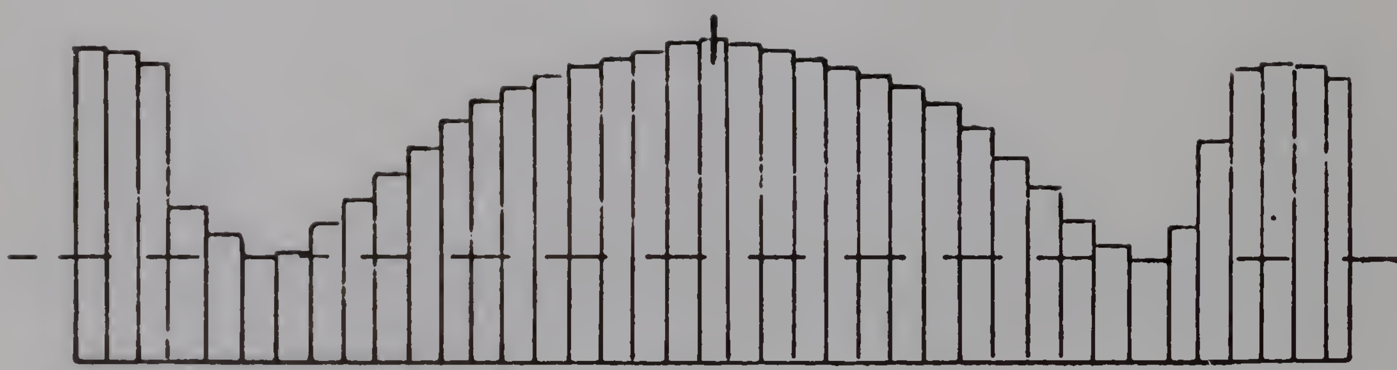


Fig. 10

Case 14

Contour transparency of duplicate denture after four months water immersion, superimposed on contour pattern of master denture. Scale X 2.

Fig. 11



Case 14

Contour transparency of duplicate denture after four months water immersion, superimposed on contour pattern of master denture. Scale X 2.

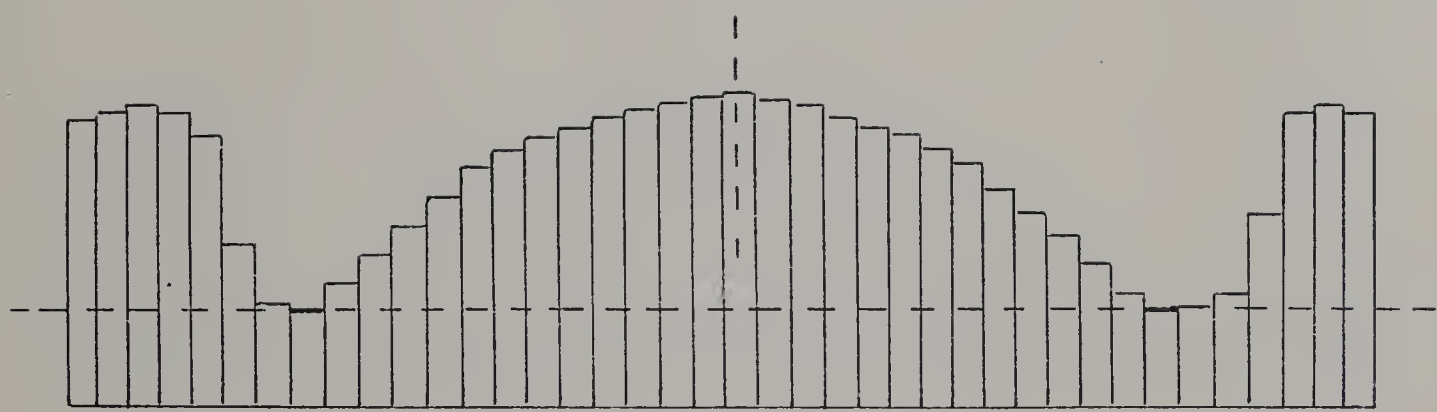
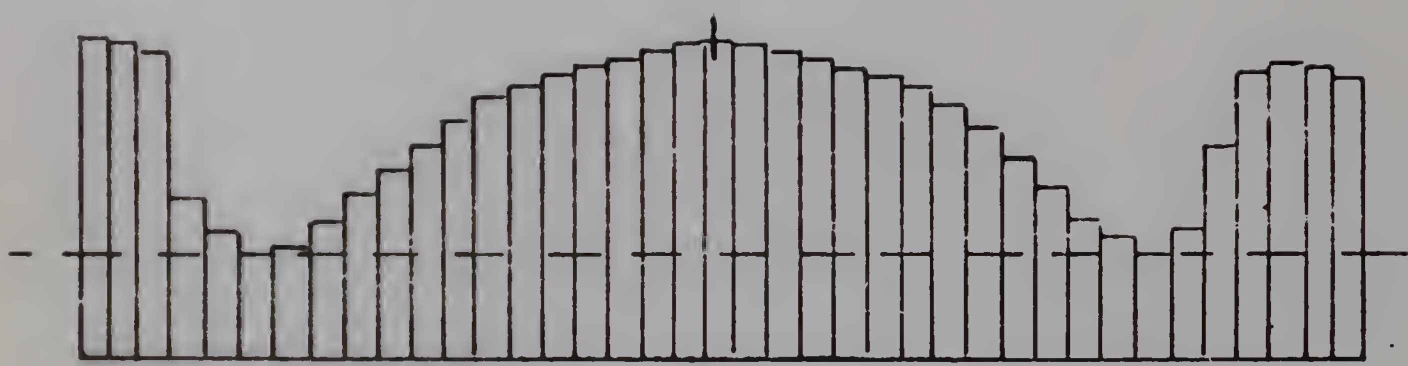


Fig. 11

Case 15

Contour transparency of duplicate denture after four months water immersion, superimposed on contour pattern of master denture. Scale X 2.

Fig. 12



Case 15

Contour transparency of duplicate denture after four months water immersion, superimposed on contour pattern of master denture. Scale X 2.

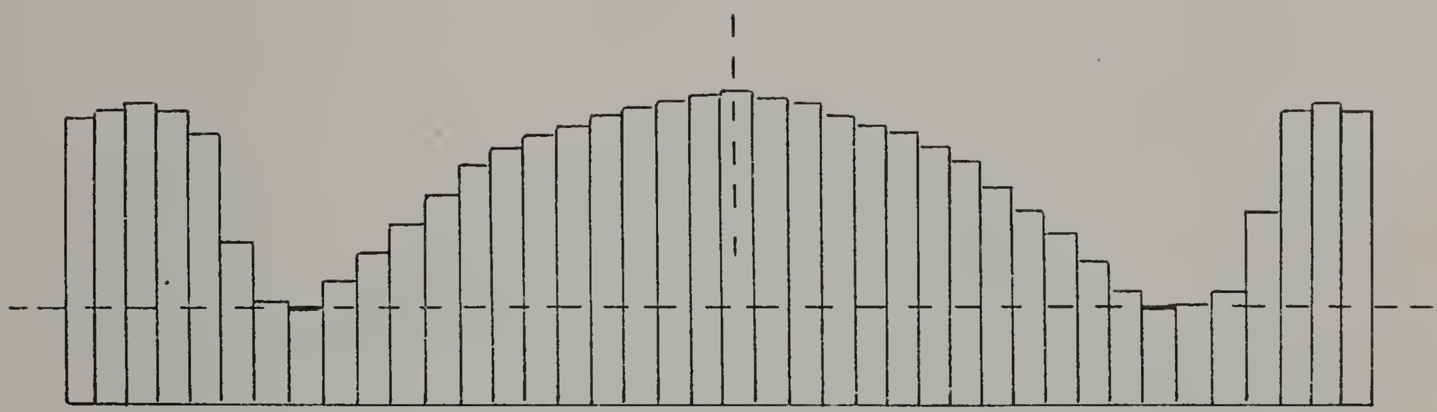
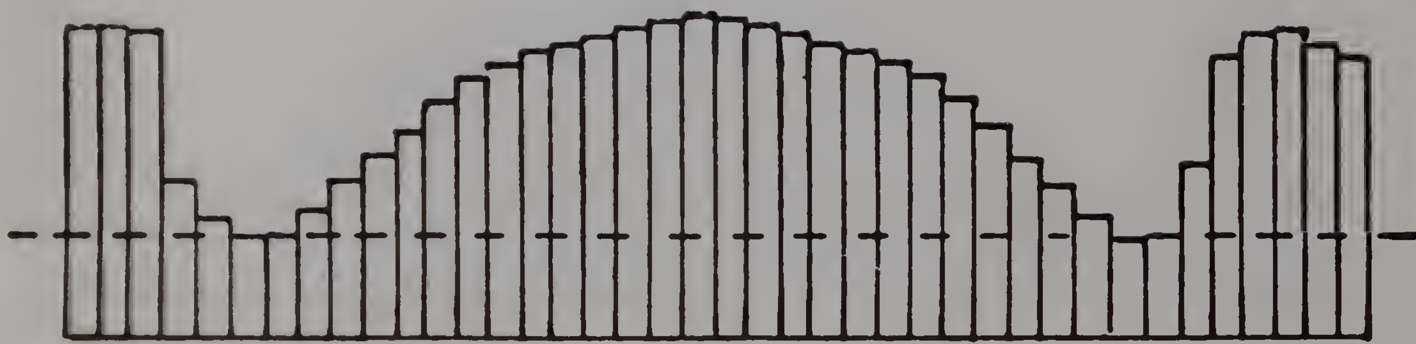


Fig. 12

Control check of master denture

Fig. 13



Control check of master denture

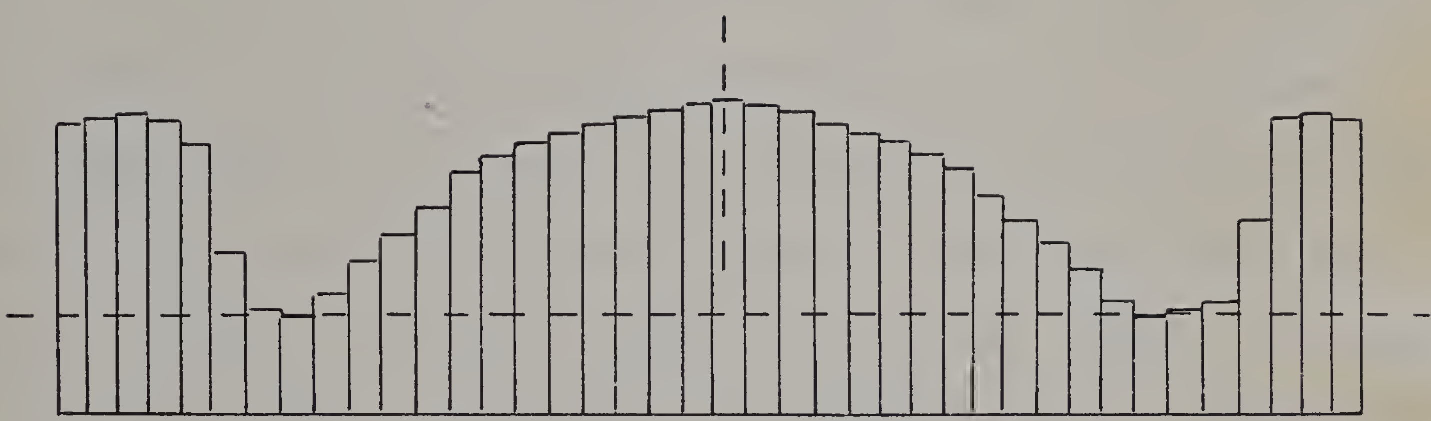


Fig. 13

Discussion

Vertical Occlusal Measurements

The results of the investigator's experiments show that there are changes in the vertical occlusal height, and that these are variable, and also that there is some correlation (Table II) between them and the linear contractions observed. Contrary to the results of other workers,[2,29,47,48] who found in most instances, a decrease of vertical dimension, with the anterior teeth showing the least change and the molar cusps the most, an increase in vertical height in the molar area was usually noted. Quite often there was also an increase of vertical height in the incisor region. A decrease of vertical height is recorded for the bicuspid region. Statistically this would occur in 87% of cases.

A negative correlation was found, between the contraction across the buccal flange width and the loss of vertical height in the bicuspid area (Table II). In other words, the less the linear contraction arising across the buccal flange width, the greater the loss of vertical height in the bicuspid region. There is also a negative correlation between the vertical height of the molar and the incisor. The less the vertical height of the molar, the greater the vertical height will be in the incisor region. An understanding of these results might be that there is a twisting or distortion of the duplicate denture base during processing.

Method of Sprueing

Skinner and Phillips[52] have noted that acrylic resin tends to shrink towards the bulkier ridge portion. In using the fluid resin technique the bulkiest area is not the ridge portion, but the sprue. Some investigators[2,29,47,48,] used a posterior sprueing technique, as described by Winkler[3] and Shephard.[29] They found the greatest loss in vertical occlusal height in the molar region. This investigator used a sprue in the centre of the palate,[1] and found the greatest loss in occlusal vertical height in the bicuspid region. In both cases, maximum vertical contraction occured in the region of the sprue attachment. The position and thickness of the sprues seems to strongly influence the ultimate position of the teeth in processed dentures. Atkinson and Grant[48] found, occasionally, an alteration of the occlusal plane, with contraction of the vertical height on one side of the denture and an increase on the other side, which they ascribed to the possibility of the cast tilting within the investing agar. This may be true, but it will not explain changes in the vertical occlusal relationships in the duplication technique[1] found by the investigator, where no cast is used. The investigator believes that the position of the sprue is of the utmost importance in determining vertical occlusal change.

The Method of Measurement

The occlusal vertical height was determined by the investigator by applying firm pressure on the calliper, while measuring

from the dimple on the ridge side of the denture to the occlusal facets. Other investigators[2,4,36,47,] determined the occlusal vertical measurements while the denture remained on the cast, and before the release of strain and the subsequent contraction caused by removal from the cast.[2,3,4,16] It would be expected that the results in the two cases would differ.

In making the linear measurements, it has been reported [2,28,31,48,] that the contraction across the buccal flange was within the range of 0.1% to 1.4%. These measurements were made after the dentures were removed from the cast. The contraction would include polymerization and thermal shrinkage and the contraction due to the release of strain. It might have been thought that in the duplication technique[1] where no stone cast is used, but an agar mould, the contraction would be less. The investigator, comparing flange to flange measurements immediately after processing, to the master denture, found an average contraction of 1.08% or - 0.633 mm. with a standard deviation of 0.1734 mm., which falls within the range documented by other investigators. The Mean was 58.131. It is conceivable however, that a denture processed by this technique,[1] will be relatively free of strain,[2,4,16,43,] polymerization and thermal shrinkage having taken place at will, due to the lack of rigidity of the agar mould.[57]

Woefel, Paffenbarger and Sweeney[5] found that the flange to flange shrinkage was greater proportionally than the molar to molar

shrinkage when processing dentures by the flask technique. Contrary to this, the results obtained by the investigator, using the palatal sprue technique,[1] show an average 1.25% (0.673 mms.) contraction across the buccal molar width, which is greater proportionally than the buccal flange contraction of (1.08%) 0.633 mms. This relatively greater shrinkage in the molar width may be caused by contraction towards the central palatal sprue. From the results obtained by the investigator, it has been shown statistically that as the buccal flange contracts, there is also molar to molar shrinkage. There is a slight positive correlation between these measurements.

There is considerable volumetric change in acrylic resins during processing, due to polymerization shrinkage.[12,15,31,43,48] On the one hand, some investigators[4,8,29,31,] claim that the necessary increase in the ratio of monomer to polymer in the mixture to increase the fluidity, in the fluid resin technique, will increase the expected contraction. On the other hand, it is thought[12] that this polymerization shrinkage is possibly compensated for, by the excess resin, and the relief of strains in the investing medium and other factors. Others[15,43,] think that strain is set up in dentures after the polymerization shrinkage and that this strain is set up during the time that the resin is cooling from polymerization temperature to room temperature.

It would appear strange that no compensation has been made for this thermal contraction of the acrylic resin, either in the

flasking technique, or the fluid resin technique, because the coefficient of thermal contraction of acrylic resin is quite high (81×10^{-6}).[4,12,13,16,33,43]

The compensations which are made for contractions, when casting molten metal, include wax expansion, expanding the mould and the provision of reservoirs and one wonders if any of these methods could be applied to acrylic resins.

It is suggested by the investigator, that was reservoirs might be attached by stalks, to the denture before investing, in the areas which show the greatest contraction. During curing and cooling, these acrylic resin reservoirs might influence the final shape of the denture, for acrylic will always tend to shrink towards the bulkiest portion.[52]

It is well documented[7,16,26,41] that chemically activated acrylic resins show less thermal contraction than heat processed acrylic resins, because it is thought, of the lower polymerization temperatures. However, Atkinson and Grant[48] investigating the fluid resin technique, have shown that the polymerization temperature within the agar mould may be as high as 80°C (160°F) and considerable thermal contraction will occur through this temperature range to room temperature. It is also interesting to speculate, that there may be distortion of the agar mould, if this polymerization temperature (160°F) 80°C be true, for Winkler and O'Conner[1] advise that the temperature of hydrocolloid should not be brought above 135° - 140°F

in the sol state and Applegate[21] considers that the best temperature for pouring reversible hydrocolloid is 130°F.

Water Sorption

Several investigators[2,31,47] observed considerable additional linear shrinkage occurred after processed dentures were placed in distilled water for 24 hours, which is the test period indicated by the American Dental Association Specification #12. The results of this study are different and changes are occurring in many dimensions. Linear measurements indicate that there is an expansion or a slight recovery towards the master denture. The flange to flange contraction has been reduced from 1.08% to 1% (0.633 mms. to 0.587 mms.) and the molar to molar from 1.25% to 1.07% (0.673 mms. to 0.575 mms.). The action of water is not unlike a plasticiser, forcing the macromolecules apart by diffusion with a possible change in the shape of the denture.[52] This may explain the increase of vertical occlusal height of the molar from 3.66% (0.311 mms.) to 4.79% (0.276 mms.) after 24 hours water immersion. At the same time it is noted that after 24 hours in water, 55% of cases would show a reduction in the vertical height of the incisor to only 0.12% (0.007 mms.) greater than the master denture. There is in most cases, a further reduction in the vertical height of the bicuspid. The percentage contraction of the bicuspid, after 24 hours water immersion compared to the master denture is now 4.12 (0.208 mms.).

After 24 hours water immersion at body temperature, there

has not only been a change in the shape of the denture, but also the pattern of occlusion has been altered.

Sweeney[15] has observed that denture bases placed in distilled water expanded until equilibrium is reached, which is at 1.5% to 2% sorption by weight, which will cause an expansion of 0.3% linearly. The investigator obtained further measurements of the denture after 4 months water immersion. Whether equilibrium conditions have been reached has not been calculated by weight[15], but is interesting to note that there has been a linear expansion across the buccal flanges of 0.35% which is a similar result to that of Sweeney[15]. The total contraction relative to the master denture is now only 0.73% (0.430 mms.). After 4 months in water there also has been an expansion in the molar to molar distance. Other investigators[47] found that dentures processed by the fluid resin technique and measured after one week in distilled water, showed practically no change from the 24 hour readings, but after 30 days the measurements indicated a return to the original dimensions. The results of the investigators experiments indicate a return towards the original shape of the denture in the linear measurements after 4 months water immersion but the occlusion is different again. The incisor has now changed position to show a contraction of 0.89% (0.054 mms.) relative to the master denture. There is still a loss of vertical height in the bicuspid region but this has been markedly reduced from 4.12% (0.208 mms.) to 2.14% (0.108 mms.) The molar has also lost vertical height. It

would appear that after four months water immersion that the denture base would be better adapted to the tissue but that the occlusion has again changed. It is suggested that these dentures should be remounted after this period of time, or when equilibrium conditions obtain, for occlusal correction.

From these results, the investigator must agree with other researchers,[15,25,26,33,52,53] that plastics continue to absorb water after the 24 hour test period[57] with consequent change in the fit of the denture.

The Contour Gauge

Difficulties were encountered in using the contour gauge. It was found that the rods of the instrument fitted the dimples in the master denture, but after duplication, and linear contraction had occurred, it was not easy to locate the rods in the dimples of the duplicate dentures. This was because of their size. It is suggested for future experiments, that the rods should be of much smaller diameter and also that the dimples should be extended laterally to allow for contraction of the denture base. Various slight inaccuracies also arise in this method because of minimal unavoidable errors in the photographs and subsequent tracings. These inaccuracies are thought to be small enough considering the changes seen in the duplication process, not to detract from the value of this method in detecting gross dimensional changes in the shape of the palatal vault of the dentures. The negatives were

developed and printed X 2, and superimposition tracings made of 5 cases. It was found from these drawings, that after the dentures have been immersed in water for 4 months, that there was a slight distortion in the region of the palatine mucous glands, which form a cushion for this area of the oral mucosa.[58] There was a maximum discrepancy of 1 mm. in the palate, in the midline, between the master denture and the duplicate denture. When this was reduced to scale, normal size, this would be of the order of 0.5 mm. It is doubtful if these changes in the shape of the palatal vault are of clinical significance because of the posterior palatal seal in that area. Dentures processed by other techniques may show greater discrepancies in the palate because it is under tensile stress.[52] The contraction of the resin in the mid palatal sprue may have a stabilizing influence on the shape of the palate when using this technique.[1] From these results, it is obvious that the greatest distortion in the duplicate denture occurs in the flanges and in the occlusion.

Clinical Application

Elderly patients have difficulty in adapting to new dentures[55,56] and it is important to retain all the well tolerated features of the old denture, particularly with regard to the polished surfaces.[51] In this regard, the duplication technique[1] is satisfactory.

Changes incurred in processing dentures may be difficult

to detect clinically[28,42,44] and from the results obtained by the investigator, such a duplicate denture, could be tolerated by the patient.[8,28,36,42,44,50,51.] Tallgren[58] has shown that according to the rate of resorption positional changes occur with dentures and are greatest during the first year. He agrees that pack changes are difficult to detect clinically. An upper denture displayed an upward and forward movement of the anterior part, the means for a 7-year period being 1.7 mm. and 1 mm. Changes incurred by the duplication process in the vertical occlusal height (Table I) are minimal compared with such positional movements. The soft tissues of the denture supporting area may accommodate the inaccuracies of the duplicating process.

It has been shown that[59] epithelium which was on the average 0.18 mm. thick in patients without complete dentures increased to 0.28 mm. in association with inflammation. It has been demonstrated that the health of the residual ridges is adversely affected by ill fitting dentures.[18] Gross occlusal discrepancies may be concealed and the retention and stability manifested, may be at the expense of the soft tissue.[17]

The dimensional changes in dentures processed by this technique[1] should not be ignored. Every effort should be made to reduce the dimensional changes occurring with the technique to avoid injury to the denture bearing area.[17,18] It would be wise to immerse the duplicate denture in water for 24 hours before

delivery to the patient. Changes in dimension have occurred and at this stage, the case should be remounted and the occlusion corrected. The time required to reach equilibrium conditions[15, 25,26,28,33,40,53] as far as water sorption is concerned, has not been determined with certainty. If the duplicate denture is to give maximum service to the patient, as a second or spare denture, further occlusal adjustments should be made after storage in water for a period of time.

Summary

The purpose of this study was to determine the accuracy of the duplication technique as outlined by Winkler and O'Connor.[1]

In order to evaluate this method, a master denture was constructed in metal to provide stability over the period of time required for the experiments. Suitable measuring reference points were incorporated in this denture. Fifteen duplicates were made and these were compared with the master denture in respect of changes in the vertical occlusal relation and linear dimensional change. Specially adjusted callipers were used for the measurements.

Readings were taken immediately after the duplicate dentures were processed and also after immersion in water for 24 hours at 37°C. A constant temperature cabinet was used to store the dentures at body heat. After 4 months in distilled water the duplicate dentures were measured again.

A contour gauge was used to compare the shape of the posterior palatal vault of the master denture and 5 duplicate dentures after they had been immersed in water for 4 months at 37°C. Silhouette photographs and tracings were made of these shapes and used for comparisons with the master denture.

Conclusions

1. Changes are evident in the vertical occlusal relation of the duplicate denture. These changes are variable. Most often there is an increase in the vertical height of the molar teeth and usually an increase in the vertical height in the incisor area but to a lesser degree. The bicuspid teeth show a definite loss of vertical height in most instances.

2. Contractions of 1.08% (0.633 mms.) are observed across the buccal flange distance and of 1.25% (0.673 mms.) across the molar to molar distance. These linear dimensional changes can be correlated to the vertical occlusal changes. There may be a twisting of the denture base.

3. Shortcomings have been found in the use of the contour gauge. Modifications would be required for future use. After 4 months water immersion at 37°C the duplicate dentures show a maximum lack of palatal adaptation in the mid line of 0.5 mm. Slight distortion is seen in the region of the palatine glands.

4. Different recordings are obtained in all dimensions, immediately after processing, after 24 hours water immersion and yet again after 4 months in water. Water sorption has a marked effect on the duplication process.

5. The position, length, and thickness of the sprue may influence both the shape of the palate and the ultimate position of the teeth in the processed denture base. A method of

compensation for the thermal contraction of the acrylic resin would be desirable. The placement of contraction reservoirs is suggested.

6. Duplicate dentures made by this technique would be satisfactory in most instances. However, it is recommended that they be remounted and the occlusion corrected.

TABLE III

FIRST MEASUREMENTS OF MASTER DENTURE (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.750	54.075	5.76	5.20	6.17
2	58.725	54.075	5.76	5.250	6.16
3	58.70	54.075	5.76	5.100	6.00
4	58.725	53.975	5.760	5.200	6.250
5	58.750	53.950	5.760	5.100	6.00
6	58.700	53.950	5.760	5.130	6.150
7	58.700	53.950	5.760	5.55	6.250
8	58.625	53.925	5.760	5.45	6.460
9	58.700	53.950	5.760	5.25	6.000
10	58.625	53.950	5.760	5.25	6.310
11	58.725	53.950	5.760	5.130	6.260
12	58.700	53.925	5.760	5.45	6.260
13	58.650	53.950	5.760	5.34	6.51
14	58.700	53.950	5.760	5.250	6.000
15	58.650	53.950	5.760	5.500	6.260

BFW = Buccal Flange Width
BMW = Buccal Molar Width
M# = Measurement Number

VHM = Vertical Height Molar
VHB = Vertical Height Bicuspid
VHI = Vertical Height Incisor

TABLE IV

MEASUREMENTS OF DUPLICATE DENTURE NO. 1 (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.675	53.300	5.850	4.55	6.340
2	58.500	53.175	5.970	4.64	6.46
3	58.400	53.150	5.760	4.590	6.32
4	58.400	53.150	5.760	4.580	6.46
5	58.475	53.150	5.760	4.580	6.46
6	58.400	53.125	5.760	4.580	6.46
7	58.425	53.200	5.650	4.580	6.46
8	58.400	53.200	5.760	4.580	6.46
9	58.450	53.200	5.650	4.580	6.46
10	58.400	53.225	5.760	4.580	6.46
11	58.400	53.200	5.760	4.580	6.46
12	58.400	53.175	5.760	4.580	6.46
13	58.375	53.200	5.450	4.580	6.46
14	58.450	53.250	5.760	4.580	6.46
15	58.400	53.200	5.760	4.580	6.46

TABLE V

MEASUREMENTS OF DUPLICATE DENTURE NO. 1 (in mm)

AFTER 24 HOURS WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.750	53.250	5.762	4.444	6.132
2	58.750	53.500	5.760	4.548	6.132
3	58.425	53.500	5.760	4.548	6.522
4	58.450	53.500	5.760	4.548	6.132
5	58.550	53.475	5.760	4.548	6.132
6	58.425	53.475	5.760	4.548	6.132
7	58.425	53.450	5.760	4.548	6.134
8	58.450	53.500	5.760	4.548	6.132
9	58.450	53.425	5.865	4.548	6.134
10	58.475	53.425	5.760	4.548	6.552
11	58.450	53.425	5.760	4.548	6.132
12	58.475	53.475	5.760	4.548	6.132
13	58.475	53.475	5.760	4.548	6.132
14	58.475	53.500	5.760	4.548	6.132
15	58.450	53.450	5.760	4.548	6.132

TABLE VI

MEASUREMENTS OF DUPLICATE DENTURE NO. 1 (in mm)

AFTER 4 MONTHS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.650	53.600	5.760	4.620	6.120
2	58.550	53.625	5.760	4.620	6.000
3	58.600	53.600	5.680	4.620	6.120
4	58.600	53.500	5.680	4.620	6.120
5	58.600	53.500	5.680	4.620	6.120
6	58.600	53.550	5.800	4.620	6.120
7	58.600	53.600	5.700	4.620	6.000
8	58.600	53.600	5.700	4.620	6.120
9	58.600	53.600	5.700	4.620	6.000
10	58.600	53.600	5.760	4.620	6.120
11	58.600	53.500	5.700	4.620	6.120
12	58.600	53.500	5.700	4.620	6.120
13	58.600	53.500	5.700	4.620	6.120
14	58.600	53.600	5.700	4.620	6.120
15	58.600	53.625	5.700	4.620	6.120

TABLE VII

SECOND MEASUREMENTS OF MASTER DENTURE (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.700	53.925	5.760	5.000	6.551
2	58.725	53.950	5.760	5.220	6.120
3	58.725	53.925	5.760	5.000	6.120
4	58.725	53.950	5.760	5.130	6.000
5	58.725	53.950	5.760	5.130	6.120
6	58.725	53.950	5.760	5.130	6.140
7	58.700	53.950	5.760	5.130	6.660
8	58.725	53.950	5.760	5.340	6.120
9	58.725	53.950	5.760	5.000	6.120
10	58.725	53.950	5.760	5.000	6.120
11	58.725	53.950	5.760	5.130	6.120
12	58.700	53.950	5.760	5.130	6.140
13	58.675	53.950	5.760	5.130	6.120
14	58.725	53.950	5.760	5.130	6.120
15	58.750	53.950	5.760	5.130	6.120

TABLE VIII

MEASUREMENTS OF DUPLICATE DENTURE NO. 2 (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.075	53.300	5.760	4.969	6.761
2	58.075	53.250	5.760	4.980	6.762
3	57.900	53.225	5.850	4.980	6.762
4	58.150	53.325	6.000	4.980	6.762
5	58.150	53.350	5.850	4.980	6.762
6	58.150	53.200	5.850	4.980	6.762
7	58.150	53.250	5.760	4.980	6.762
8	58.150	53.250	5.760	4.980	6.762
9	58.150	53.300	5.760	4.980	6.762
10	58.050	53.300	5.760	4.980	6.762
11	58.150	53.300	5.760	4.980	6.760
12	58.150	53.225	5.760	5.000	6.762
13	58.150	53.300	5.760	5.000	6.762
14	58.150	53.300	5.760	4.980	6.762
15	58.150	53.250	5.760	4.980	6.762

TABLE IX

MEASUREMENTS OF DUPLICATE DENTURE NO. 2 (in mm)

AFTER 24 HOURS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.200	53.625	6.000	4.820	6.260
2	58.100	53.625	5.760	4.620	6.280
3	58.200	53.500	5.760	4.552	6.000
4	58.100	53.500	5.960	4.556	6.000
5	58.175	53.600	5.960	4.500	6.000
6	58.100	53.550	5.860	4.820	6.260
7	58.100	53.600	5.760	4.820	6.260
8	58.050	53.600	5.900	4.720	6.260
9	58.000	53.625	5.760	4.720	6.260
10	58.125	53.625	5.880	4.720	6.360
11	58.100	53.500	5.800	4.760	6.360
12	58.125	53.550	5.760	4.720	6.160
13	58.075	53.600	5.760	4.720	6.260
14	58.125	53.550	5.760	4.760	6.320
15	58.125	53.500	5.760	4.760	6.260

TABLE X

MEASUREMENTS OF DUPLICATE DENTURE NO. 2 (in mm)

AFTER 4 MONTHS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.300	53.650	5.680	4.880	6.100
2	58.350	53.650	5.720	4.860	6.140
3	58.300	53.700	5.700	5.000	6.100
4	58.300	53.700	5.700	5.000	6.120
5	58.300	53.700	5.680	4.920	6.140
6	58.350	53.600	5.700	4.920	6.000
7	58.300	53.600	5.700	4.920	6.000
8	58.350	53.700	5.700	4.880	6.120
9	58.300	53.700	5.700	4.880	6.140
10	58.300	53.700	5.680	4.900	6.140
11	58.300	53.650	5.700	5.000	6.100
12	58.350	53.650	5.700	4.920	6.100
13	58.250	53.650	5.700	4.920	6.100
14	58.350	53.650	5.700	5.000	6.140
15	58.250	53.700	5.700	5.000	6.100

TABLE XI

THIRD MEASUREMENTS OF MASTER DENTURE (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.950	53.950	6.000	5.760	6.656
2	58.725	53.950	5.865	5.760	6.520
3	58.700	53.900	5.760	5.760	6.220
4	58.700	53.925	5.760	5.130	6.320
5	58.850	53.925	5.760	5.000	6.000
6	58.700	53.900	5.760	5.130	6.000
7	58.950	53.900	5.760	5.000	6.000
8	58.950	53.900	5.760	5.000	6.970
9	58.950	53.925	5.760	5.000	6.000
10	58.700	53.925	5.760	5.000	6.000
11	58.750	53.950	5.760	5.000	6.000
12	58.750	53.900	5.760	5.000	6.000
13	58.700	53.900	5.760	5.500	6.000
14	58.700	53.950	5.760	5.580	6.000
15	58.725	53.925	5.760	5.580	6.000

TABLE XII

MEASUREMENTS OF DUPLICATE DENTURE NO. 3 (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.125	53.500	5.340	5.000	6.520
2	58.250	53.975	5.450	5.130	6.342
3	58.225	53.450	5.550	4.850	6.000
4	58.000	53.450	5.130	5.000	6.552
5	58.000	53.800	5.130	4.980	6.552
6	58.100	53.250	5.250	4.968	6.865
7	58.100	53.400	5.130	4.968	6.970
8	58.000	53.400	5.130	4.864	6.970
9	58.000	53.250	5.340	4.864	6.970
10	58.050	53.450	5.760	4.968	6.970
11	58.100	53.325	5.450	4.968	6.970
12	58.000	53.400	5.450	4.968	6.568
13	58.150	53.300	5.340	4.864	6.236
14	58.100	53.300	5.130	4.864	6.132
15	58.075	53.325	5.130	4.864	6.760

TABLE XIII

MEASUREMENTS OF DUPLICATE DENTURE NO. 3 (in mm)

AFTER 24 HOURS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.100	53.300	5.180	4.720	6.100
2	58.125	53.250	5.554	4.820	6.120
3	58.100	53.325	5.260	4.820	6.160
4	58.100	53.350	5.620	4.720	6.200
5	58.075	53.250	5.760	4.720	6.120
6	58.125	53.300	5.360	4.720	6.120
7	58.100	53.300	5.340	4.720	6.120
8	58.125	53.300	5.620	4.720	6.120
9	58.075	53.275	5.340	4.920	6.100
10	58.150	53.300	5.340	4.720	6.120
11	58.125	53.300	5.760	4.720	6.120
12	58.125	53.300	5.540	4.820	6.132
13	58.125	53.300	5.340	4.820	6.120
14	58.075	53.300	5.340	4.820	6.120
15	58.100	53.300	5.340	4.720	6.120

TABLE XIV

MEASUREMENTS OF DUPLICATE DENTURE NO. 3 (in mm)

AFTER 4 MONTHS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.300	53.700	5.500	5.000	5.980
2	58.325	53.700	5.540	4.950	6.000
3	58.250	53.700	5.500	4.950	5.980
4	58.300	53.600	5.500	5.000	5.980
5	58.300	53.600	5.540	5.000	6.000
6	58.250	53.700	5.500	5.000	6.000
7	58.250	53.000	5.500	5.000	5.980
8	58.250	53.600	5.500	4.920	5.980
9	58.300	53.700	5.500	5.000	6.000
10	58.250	53.600	5.540	4.920	5.980
11	58.250	53.600	5.500	4.920	6.000
12	58.250	53.600	5.500	5.000	6.000
13	58.250	53.575	5.500	4.940	5.980
14	58.250	53.600	5.500	4.980	5.980
15	58.300	53.600	5.500	5.000	6.000

TABLE XV

FOURTH MEASUREMENTS OF MASTER DENTURE (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.750	53.900	5.800	5.000	6.000
2	58.750	53.900	5.760	4.920	6.000
3	58.750	53.900	5.760	4.920	6.000
4	58.750	53.925	5.760	5.000	6.000
5	58.750	53.900	5.760	5.000	6.200
6	58.750	53.900	5.760	5.000	6.000
7	58.750	53.900	5.760	5.000	6.100
8	58.750	53.900	5.760	5.000	6.000
9	58.800	53.900	5.760	5.100	6.000
10	58.750	53.900	5.760	5.000	6.000
11	58.750	53.900	5.760	5.000	6.000
12	58.825	53.900	5.760	5.000	6.280
13	58.750	53.900	5.760	5.260	6.200
14	58.750	53.875	5.760	5.000	6.000
15	58.750	53.900	5.760	5.000	6.000

TABLE XVI

MEASUREMENTS OF DUPLICATE DENTURE NO. 4 (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.400	53.300	5.760	4.444	6.552
2	58.225	53.225	6.000	4.444	6.000
3	58.350	53.175	6.000	4.548	6.000
4	58.250	53.250	6.000	4.548	6.342
5	58.250	53.300	6.000	4.548	6.132
6	58.400	53.200	6.000	4.548	6.000
7	58.250	53.300	6.000	4.548	6.970
8	58.200	53.350	6.000	4.548	6.000
9	58.300	53.350	6.000	4.548	6.000
10	58.250	53.350	6.000	4.548	6.000
11	58.300	53.325	6.000	4.548	6.000
12	58.250	53.350	6.000	4.548	6.000
13	58.350	53.350	6.000	4.338	6.000
14	58.200	53.250	6.000	4.548	6.000
15	58.225	53.325	6.000	4.548	6.000

TABLE XVII

MEASUREMENTS OF DUPLICATE DENTURE NO. 4 (in mm)

AFTER 24 HOURS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.225	53.250	6.420	4.480	6.000
2	58.150	63.250	6.320	4.580	6.000
3	58.175	53.250	6.000	4.580	6.000
4	58.200	53.250	6.000	4.580	6.000
5	58.225	53.250	6.120	4.680	5.900
6	58.200	53.250	6.120	4.580	6.000
7	58.200	53.250	6.120	4.580	6.000
8	58.200	53.200	6.120	4.580	6.000
9	58.200	53.250	6.120	4.480	6.120
10	58.200	53.250	6.120	4.480	5.900
11	58.200	53.250	6.120	4.480	5.980
12	58.200	53.250	6.120	4.480	6.000
13	58.225	53.250	6.120	4.480	6.000
14	58.200	53.250	6.120	4.680	6.000
15	58.225	53.250	6.120	4.480	6.000

TABLE XVIII

MEASUREMENTS OF DUPLICATE DENTURE NO. 4 (in mm)

AFTER 4 MONTHS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.400	53.350	6.320	4.440	6.000
2	58.375	53.350	6.300	4.500	6.000
3	58.300	53.350	6.200	4.500	6.000
4	58.300	53.350	6.300	4.500	6.000
5	58.350	53.350	6.280	4.500	6.000
6	58.350	53.350	6.280	4.500	6.000
7	58.350	53.400	6.280	4.440	6.000
8	58.350	53.350	6.300	4.500	6.100
9	58.350	53.400	6.280	4.500	6.000
10	58.375	53.350	6.280	4.500	6.000
11	58.400	53.400	6.300	4.500	6.000
12	58.400	53.350	6.300	4.500	6.100
13	58.350	53.400	6.280	4.500	6.000
14	58.350	53.350	6.280	4.440	6.000
15	58.400	53.400	6.280	4.500	6.100

TABLE XIX

FIFTH MEASUREMENTS OF MASTER DENTURE (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.975	53.900	5.760	4.920	6.000
2	58.750	53.900	5.760	5.000	6.000
3	58.775	53.925	5.760	5.000	6.000
4	58.750	53.925	5.760	5.000	6.000
5	58.825	53.900	5.760	5.000	6.000
6	58.775	53.900	5.760	5.000	6.000
7	58.775	53.900	5.760	5.000	6.000
8	58.775	53.900	5.760	5.000	6.200
9	58.800	53.900	5.760	5.000	6.200
10	58.800	53.900	5.760	5.000	6.000
11	58.800	53.900	5.760	5.120	6.000
12	58.800	53.925	5.760	5.200	6.200
13	58.800	53.900	5.760	5.280	6.000
14	58.800	53.900	5.760	5.300	6.000
15	58.900	53.900	5.760	5.000	6.000

TABLE XX

MEASUREMENTS OF DUPLICATE DENTURE NO. 5 (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.200	53.275	5.760	5.000	6.762
2	58.200	53.250	5.760	5.000	6.342
3	58.200	53.300	6.000	4.968	6.000
4	58.250	53.300	5.760	5.000	6.000
5	58.250	58.325	5.760	4.968	6.000
6	58.250	53.325	5.760	4.968	6.000
7	58.250	53.300	5.760	4.968	6.000
8	58.100	53.275	5.760	4.968	6.000
9	58.200	53.300	5.760	4.968	6.000
10	58.200	53.300	5.760	5.000	6.000
11	58.150	53.275	5.865	4.968	6.000
12	58.050	53.300	5.760	5.000	6.000
13	58.200	53.300	5.760	5.000	6.000
14	58.200	53.300	5.760	5.000	6.000
15	58.225	53.275	5.760	5.340	6.000

TABLE XXI

MEASUREMENTS OF DUPLICATE DENTURE NO. 5 (in mm)

AFTER 24 HOURS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.125	53.325	6.000	4.680	5.760
2	58.125	53.325	5.900	4.580	5.760
3	58.150	53.275	5.800	4.580	5.800
4	58.100	53.300	5.900	4.580	6.000
5	58.100	53.300	5.900	4.580	6.000
6	58.100	53.300	5.880	4.580	6.000
7	58.100	53.300	5.900	4.580	4.760
8	58.200	53.300	5.880	4.580	5.920
9	58.100	53.300	6.000	4.760	5.900
10	58.100	53.300	5.900	4.680	5.900
11	58.100	53.300	5.900	4.580	6.000
12	58.125	53.300	6.000	4.580	6.000
13	58.100	53.325	6.000	4.780	5.900
14	58.150	53.300	6.000	4.680	5.900
15	58.150	53.300	6.000	4.680	6.000

TABLE XXII

MEASUREMENTS OF DUPLICATE DENTURE NO. 5 (in mm)

AFTER 4 MONTHS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.300	53.550	5.900	4.800	5.880
2	58.375	53.550	5.900	4.780	5.860
3	58.300	53.550	5.880	4.800	5.900
4	58.300	53.550	5.880	4.800	5.800
5	58.300	53.550	5.960	4.850	5.800
6	58.300	53.550	5.940	4.820	5.800
7	58.300	53.550	5.960	4.820	5.800
8	58.300	53.550	5.900	4.800	5.800
9	58.300	53.600	5.900	4.820	5.800
10	58.300	53.550	5.900	4.800	5.800
11	58.300	53.550	5.960	4.820	5.800
12	58.300	53.550	5.900	4.800	5.800
13	58.300	53.550	5.960	4.800	5.800
14	58.300	53.550	5.900	4.800	5.800
15	58.300	53.550	5.960	4.800	5.800

TABLE XXIII

SIXTH MEASUREMENTS OF MASTER DENTURE (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.800	53.900	5.900	4.840	6.000
2	58.750	53.900	5.760	5.200	6.000
3	58.800	53.900	5.760	5.320	6.000
4	58.750	53.900	5.900	5.320	6.000
5	58.750	53.900	5.760	5.230	6.000
6	58.750	53.900	5.760	5.200	6.000
7	58.750	53.900	5.760	5.120	6.000
8	58.750	53.925	5.760	5.120	6.000
9	58.800	53.900	5.760	5.300	6.000
10	58.750	53.900	5.760	5.300	6.000
11	58.900	53.925	5.760	5.300	6.000
12	58.900	53.900	5.760	5.300	6.000
13	58.800	53.900	5.760	5.200	6.000
14	58.750	53.900	5.760	5.200	6.000
15	58.750	53.925	5.760	5.200	6.000

TABLE XXIV

MEASUREMENTS OF DUPLICATE DENTURE NO. 6 (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	57.700	53.35	5.800	4.880	6.000
2	57.700	53.350	5.820	4.720	6.000
3	58.250	53.250	5.700	4.720	5.920
4	58.500	53.325	5.700	4.520	5.920
5	58.150	53.250	5.820	4.720	5.920
6	58.200	53.300	5.800	4.720	5.900
7	58.150	53.250	5.800	4.720	5.900
8	58.150	53.250	6.000	4.720	6.000
9	58.200	53.250	6.000	4.620	6.000
10	58.200	53.250	6.000	4.620	6.000
11	58.200	53.250	5.700	4.880	5.800
12	58.200	53.250	6.000	4.880	5.800
13	58.150	53.250	5.900	4.880	6.000
14	58.150	53.250	5.900	4.880	6.000
15	58.150	53.250	5.780	4.880	6.000

TABLE XXV

MEASUREMENTS OF DUPLICATE DENTURE NO. 6 (in mm)

AFTER 24 HOURS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	57.950	53.400	5.900	5.100	5.940
2	57.750	53.425	5.760	4.720	6.000
3	57.800	53.400	6.000	4.720	6.000
4	57.825	53.400	5.880	4.820	5.900
5	57.800	53.400	5.900	4.820	5.900
6	58.050	53.375	5.800	4.720	5.900
7	58.100	53.375	5.800	4.720	6.000
8	58.125	53.375	6.000	4.720	5.900
9	58.050	53.350	5.760	4.720	6.000
10	58.050	53.350	5.800	4.820	6.000
11	58.100	53.400	5.900	4.820	5.900
12	58.100	53.400	5.900	4.780	5.900
13	58.150	53.450	5.900	4.780	5.900
14	58.125	53.450	5.900	4.780	5.880
15	58.100	53.350	5.900	4.780	6.000

TABLE XXVI

MEASUREMENTS OF DUPLICATE DENTURE NO. 6 (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.300	53.600	5.500	5.000	5.900
2	58.300	53.600	5.500	5.000	5.900
3	58.300	53.625	5.580	5.000	5.900
4	58.325	53.600	5.580	5.000	5.900
5	58.325	53.600	5.540	5.000	5.900
6	58.300	53.600	5.540	5.100	6.000
7	58.300	53.600	5.540	5.100	5.900
8	58.325	53.600	5.600	5.000	5.900
9	58.300	53.600	5.580	5.000	5.900
10	58.300	53.600	5.580	5.000	6.000
11	58.300	53.600	5.600	5.000	6.000
12	58.300	53.625	5.600	4.980	6.000
13	58.300	53.600	5.600	5.000	5.900
14	58.300	53.625	5.600	5.000	5.900
15	58.325	53.600	5.600	5.000	6.000

TABLE XXVII

SEVENTH MEASUREMENTS OF MASTER DENTURE (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.800	53.850	5.680	5.000	6.000
2	58.700	53.800	5.760	4.920	6.100
3	58.700	53.850	5.760	5.120	6.100
4	58.700	53.875	5.760	5.000	6.000
5	58.700	53.875	5.760	4.920	6.000
6	58.725	53.875	5.760	5.000	6.100
7	58.700	53.900	5.760	5.000	6.000
8	58.700	53.900	5.760	5.000	6.000
9	58.725	53.900	5.760	5.000	6.000
10	58.700	53.900	5.760	4.980	6.120
11	58.700	53.900	5.760	4.960	6.120
12	58.725	53.850	5.900	5.000	6.000
13	58.700	53.850	5.760	5.000	6.120
14	58.700	53.900	5.760	4.960	6.000
15	58.700	53.900	5.760	4.980	6.000

TABLE XXVIII

MEASUREMENTS OF DUPLICATE DENTURE NO. 7 (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.150	53.000	6.200	5.000	6.500
2	58.000	53.000	6.300	5.000	6.000
3	58.000	53.000	6.120	5.000	6.500
4	58.150	53.025	6.120	5.000	6.100
5	58.150	53.000	6.520	5.000	6.100
6	57.725	53.000	6.420	5.000	6.200
7	57.900	53.000	6.420	5.000	6.100
8	57.900	53.000	5.900	5.000	6.100
9	58.100	53.000	5.900	5.000	6.120
10	58.100	53.000	5.900	5.000	6.120
11	57.800	53.000	5.900	5.000	6.000
12	57.775	53.000	5.900	5.000	6.000
13	57.800	53.000	5.900	5.000	6.000
14	57.950	53.000	5.900	5.000	6.000
15	57.850	53.000	6.000	5.000	6.000

TABLE XXIX

MEASUREMENTS OF DUPLICATE DENTURE NO. 7 (in mm)

AFTER 24 HOURS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.225	53.275	6.000	5.000	6.100
2	58.400	53.225	6.100	5.000	6.000
3	58.350	53.225	6.100	5.100	6.000
4	58.350	53.225	6.100	5.000	5.900
5	58.400	53.225	6.100	5.200	6.000
6	58.300	53.150	6.100	5.000	5.900
7	58.275	53.225	6.100	5.000	5.900
8	58.300	53.250	6.100	5.200	5.760
9	58.400	53.250	6.100	5.000	6.100
10	58.400	53.200	6.000	5.000	6.100
11	58.400	53.200	6.000	5.000	6.100
12	58.400	53.200	6.000	5.100	6.000
13	58.300	53.250	6.000	5.000	6.240
14	58.300	53.250	6.000	5.000	5.980
15	58.325	53.200	6.000	5.100	5.880

TABLE XXX

MEASUREMENTS OF DUPLICATE DENTURE NO. 7 (in mm)

AFTER 4 MONTHS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.450	53.400	6.000	5.100	5.980
2	58.450	53.400	6.000	5.100	5.980
3	58.450	53.400	6.000	5.000	6.000
4	58.450	53.475	6.000	5.000	5.980
5	58.450	53.400	6.000	5.000	5.980
6	58.450	53.450	6.000	5.100	5.980
7	58.450	53.400	6.000	5.100	6.000
8	58.450	53.450	6.000	5.100	6.000
9	58.450	53.400	6.000	5.100	6.000
10	58.450	53.400	6.000	5.100	6.000
11	58.450	53.450	6.000	5.100	6.000
12	58.450	53.450	6.000	5.000	6.000
13	58.450	53.400	6.000	5.000	6.000
14	58.450	53.400	6.000	5.000	6.000
15	58.450	53.450	6.000	5.000	6.000

TABLE XXXI

EIGHTH MEASUREMENTS OF MASTER DENTURE (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.750	53.900	5.760	5.000	6.000
2	58.750	53.850	5.760	5.240	6.000
3	58.750	53.900	5.760	5.100	6.000
4	58.750	53.900	5.760	5.000	6.000
5	58.775	53.900	5.760	5.000	6.000
6	58.700	53.875	5.760	4.880	6.000
7	58.800	53.900	5.760	4.980	6.000
8	58.750	53.875	5.760	4.960	6.000
9	58.800	53.800	5.760	4.960	6.000
10	58.800	53.875	5.760	5.000	6.000
11	58.800	53.875	5.760	5.000	6.000
12	58.800	53.800	5.760	4.960	6.000
13	58.775	53.875	5.760	4.960	6.000
14	58.800	53.900	5.760	5.000	6.000
15	58.800	53.900	5.760	5.000	6.000

TABLE XXXII

MEASUREMENTS OF DUPLICATE DENTURE NO. 8 (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.425	53.200	6.360	4.920	6.100
2	58.400	53.125	6.320	4.920	5.880
3	58.300	53.300	6.120	4.920	6.000
4	58.425	53.200	6.200	4.920	6.100
5	58.425	53.200	6.300	4.920	6.100
6	58.475	53.125	6.200	4.920	6.100
7	58.400	53.200	6.200	4.920	6.100
8	58.500	53.300	6.200	4.920	6.180
9	58.425	53.200	6.000	4.920	6.150
10	58.425	53.200	6.000	4.920	6.000
11	58.450	53.200	6.120	4.920	6.000
12	58.400	53.250	6.120	4.920	6.300
13	58.400	53.250	6.300	4.920	6.300
14	58.375	53.200	6.300	4.920	6.120
15	58.400	53.200	6.000	4.920	6.120

TABLE XXXIII

MEASUREMENTS OF DUPLICATE DENTURE NO. 8 (in mm)

AFTER 24 HOURS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.500	53.325	6.000	4.740	6.200
2	58.400	53.275	6.800	4.820	6.360
3	58.375	53.250	6.500	4.920	6.000
4	58.500	53.350	6.600	4.820	6.200
5	58.400	53.300	6.300	4.880	6.400
6	58.450	53.300	6.800	4.900	6.200
7	58.450	53.300	6.500	4.900	6.200
8	58.350	53.250	6.450	4.900	6.300
9	58.400	53.300	6.540	4.820	6.200
10	58.400	53.275	6.520	4.780	6.400
11	58.400	53.300	6.420	4.980	6.400
12	58.375	53.250	6.400	4.940	6.300
13	58.375	53.250	6.400	4.940	6.200
14	58.400	53.275	6.400	4.940	6.500
15	58.375	53.300	6.260	4.920	6.400

TABLE XXXIV

MEASUREMENTS OF DUPLICATE DENTURES NO. 8 (in mm)

AFTER 4 MONTHS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.500	53.475	6.300	4.960	6.100
2	58.650	53.400	6.275	4.960	6.100
3	58.650	53.475	6.275	4.960	6.100
4	58.600	53.450	6.300	4.960	6.100
5	58.650	53.450	6.200	5.000	6.100
6	58.650	53.450	6.250	5.000	6.100
7	58.600	53.450	6.275	5.000	6.100
8	58.700	53.475	6.275	5.000	6.100
9	58.650	53.450	6.275	5.000	6.100
10	58.650	53.475	6.275	5.000	6.100
11	58.650	53.450	6.280	5.000	6.100
12	58.600	53.475	6.280	5.000	6.100
13	58.650	53.450	6.275	5.000	6.100
14	58.650	53.450	6.275	5.000	6.100
15	58.650	53.475	6.275	5.000	6.100

TABLE XXXV

NINETH MEASUREMENTS OF MASTER DENTURE (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.650	53.900	5.760	4.900	6.100
2	58.700	53.875	5.760	5.000	6.000
3	58.700	53.950	5.760	4.900	6.100
4	58.750	53.950	5.760	4.900	6.100
5	58.750	53.950	5.760	4.900	6.100
6	58.800	53.950	5.760	4.900	6.100
7	58.800	53.950	5.760	5.000	6.000
8	58.700	53.950	5.760	5.000	6.100
9	58.750	53.950	5.760	4.900	6.100
10	58.750	53.950	5.760	4.900	6.100
11	58.750	53.900	5.760	4.900	6.120
12	58.750	53.925	5.760	5.000	6.300
13	58.750	53.900	5.760	5.000	6.200
14	58.700	53.900	5.760	5.000	6.300
15	58.700	53.900	5.760	5.000	6.200

TABLE XXXVI

MEASUREMENTS OF DUPLICATE DENTURE NO. 9 (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.250	53.450	6.100	4.920	6.100
2	58.250	53.450	6.400	4.760	6.230
3	58.250	53.450	6.460	4.840	6.440
4	58.275	53.400	6.500	4.840	6.400
5	58.250	53.400	6.400	4.840	6.400
6	58.250	53.400	6.380	4.760	6.400
7	58.250	53.450	6.500	4.920	6.500
8	58.250	53.450	6.300	4.920	6.400
9	58.250	53.450	6.500	4.920	6.120
10	58.250	53.400	6.500	4.920	6.120
11	58.300	53.400	6.500	4.920	6.000
12	58.350	53.450	6.500	4.760	6.000
13	58.300	53.450	6.500	4.860	6.000
14	58.300	53.400	6.300	4.860	6.120
15	58.300	53.400	6.300	4.860	6.000

TABLE XXXVII

MEASUREMENTS OF DUPLICATE DENTURE NO. 9 (in mm)

AFTER 24 HOURS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.350	53.400	6.500	5.100	6.480
2	58.350	53.400	6.500	5.100	6.400
3	58.350	53.475	6.500	5.100	6.450
4	58.375	53.475	6.500	5.100	6.100
5	58.400	53.475	6.500	5.100	6.200
6	58.400	53.500	6.500	5.200	6.000
7	58.400	53.500	6.500	5.200	6.000
8	58.400	53.500	6.500	5.200	6.160
9	58.400	53.475	6.500	5.100	6.500
10	58.350	53.475	6.500	5.200	6.120
11	58.400	53.475	6.500	5.100	6.000
12	58.400	53.475	6.500	5.200	6.300
13	58.400	53.475	6.500	5.100	6.000
14	58.400	53.475	6.500	5.100	6.100
15	58.400	53.450	6.500	5.100	6.300

TABLE XXXVIII

MEASUREMENTS OF DUPLICATE DENTURE NO. 9 (in mm)

AFTER 4 MONTHS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.550	53.525	6.480	5.100	6.140
2	58.500	53.500	6.400	5.100	6.140
3	58.500	53.600	6.400	5.000	5.900
4	58.550	53.600	6.400	5.100	6.000
5	58.500	53.600	6.500	5.100	6.000
6	58.500	53.600	6.480	5.100	5.900
7	58.550	53.600	6.480	5.100	5.900
8	58.550	53.600	6.400	5.100	6.000
9	58.500	53.600	6.400	5.100	6.000
10	58.500	53.600	6.400	5.100	6.000
11	58.500	53.575	6.400	5.100	6.000
12	58.500	53.550	6.400	5.100	5.900
13	58.500	53.600	6.400	5.100	6.000
14	58.550	53.600	6.400	5.100	6.000
15	58.500	53.600	6.400	5.100	6.000

TABLE XXXIX

TENTH MEASUREMENTS OF MASTER DENTURE (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.775	53.900	5.760	4.920	6.120
2	58.800	53.900	5.760	4.900	6.000
3	58.750	53.900	5.760	4.900	6.220
4	58.750	53.900	5.760	4.900	6.000
5	58.750	53.900	5.760	4.900	6.000
6	58.750	53.900	5.760	4.900	6.000
7	58.750	53.900	5.760	5.000	6.000
8	58.750	53.900	5.760	5.000	6.000
9	58.725	53.900	5.760	4.900	6.120
10	58.750	53.900	5.760	4.900	6.120
11	58.750	53.900	5.760	4.900	6.120
12	58.700	53.900	5.760	4.900	6.200
13	58.750	53.900	5.760	5.000	6.000
14	58.750	53.900	5.760	5.000	6.000
15	58.750	53.900	5.760	4.900	6.100

TABLE XL

MEASUREMENTS OF DUPLICATE DENTURE NO. 10 (in mm)

AFTER 24 HOURS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	57.950	53.250	6.000	4.920	6.000
2	57.900	53.300	6.000	4.920	6.200
3	57.900	53.300	6.120	5.000	6.000
4	57.900	53.250	6.000	5.000	6.000
5	57.950	53.250	6.000	4.920	6.000
6	57.950	53.300	6.000	4.920	6.320
7	57.900	53.300	6.000	5.000	6.000
8	57.900	53.300	6.000	5.000	6.000
9	57.900	53.350	6.000	5.000	6.000
10	57.875	53.300	6.000	5.000	6.200
11	57.900	53.100	6.000	5.000	6.000
12	57.800	53.350	6.000	5.000	6.280
13	57.800	53.200	6.000	5.000	6.200
14	58.000	53.350	6.000	5.000	6.200
15	57.900	53.350	6.000	5.000	6.280

TABLE XLI

MEASUREMENTS OF DUPLICATE DENTURE NO. 10 (in mm)

AFTER 24 HOURS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.000	53.400	6.400	5.100	6.280
2	57.925	53.500	6.120	4.900	6.200
3	57.925	53.425	6.000	4.900	6.200
4	57.925	53.500	6.200	5.000	6.200
5	57.975	53.400	6.100	5.000	6.100
6	57.950	53.400	6.100	4.900	6.220
7	57.950	53.400	6.100	4.900	6.300
8	57.950	53.350	6.100	4.900	6.280
9	57.925	53.375	6.200	4.700	6.100
10	57.925	53.400	6.200	4.900	6.000
11	57.950	53.375	6.200	5.000	6.100
12	57.950	53.375	6.200	5.000	6.400
13	57.950	53.400	6.100	4.700	6.300
14	57.900	53.400	6.100	4.700	6.500
15	57.900	53.400	6.100	4.900	6.460

TABLE XLII

MEASUREMENTS OF DUPLICATE DENTURE NO. 10 (in mm)

AFTER 4 MONTHS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.075	53.500	6.100	5.360	6.200
2	58.000	53.500	6.100	5.380	6.100
3	58.100	53.500	6.100	5.360	6.100
4	58.100	53.500	6.100	5.360	6.100
5	58.000	53.475	6.100	5.400	6.100
6	58.100	53.500	6.100	5.360	6.100
7	58.100	53.500	6.100	5.360	6.100
8	58.000	53.500	6.100	5.360	6.100
9	58.000	53.500	6.100	5.140	6.100
10	58.000	53.475	6.100	5.360	6.100
11	58.000	53.475	6.100	5.300	6.100
12	58.000	53.500	6.100	5.300	6.100
13	58.000	53.500	6.100	5.300	6.100
14	58.000	53.500	6.100	5.360	6.100
15	58.000	53.500	6.100	5.360	6.100

TABLE XLIII

ELEVENTH MEASUREMENTS OF MASTER DENTURE (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.700	53.900	5.760	4.920	6.000
2	58.750	53.875	5.760	5.000	6.100
3	58.750	53.875	5.760	5.000	6.000
4	58.725	53.900	5.760	4.900	6.000
5	58.750	53.900	5.760	4.920	6.300
6	58.750	53.900	5.760	5.000	6.000
7	58.750	53.875	5.760	5.000	6.100
8	58.700	53.875	5.760	5.000	6.000
9	58.750	53.875	5.760	5.000	6.000
10	58.700	53.900	5.760	5.000	6.000
11	58.750	53.875	5.760	4.960	6.000
12	58.800	53.900	5.760	4.900	6.000
13	58.750	53.900	5.760	5.100	6.100
14	58.750	53.900	5.760	4.900	6.000
15	58.800	53.875	5.820	4.980	6.000

TABLE XLIV

MEASUREMENTS OF DUPLICATE DENTURE NO. 11 (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.000	53.125	5.800	5.100	6.200
2	57.875	53.100	5.780	5.000	6.100
3	57.800	53.100	6.080	4.900	6.000
4	57.800	53.100	5.900	5.000	6.000
5	57.850	53.100	5.900	5.000	6.000
6	57.850	53.100	5.900	5.000	6.200
7	57.800	53.100	5.900	5.000	6.100
8	57.800	53.100	5.900	5.000	6.100
9	57.800	53.100	5.900	4.900	6.000
10	57.800	53.100	5.900	4.900	6.100
11	57.800	53.100	5.900	5.000	6.100
12	57.850	53.100	6.000	5.000	6.100
13	57.800	53.100	6.000	5.000	6.100
14	57.850	53.125	6.000	5.000	6.000
15	57.800	53.100	6.000	4.900	6.100

TABLE XLV

MEASUREMENTS OF DUPLICATE DENTURE NO. 11 (in mm)

AFTER 24 HOURS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	57.850	53.200	6.000	4.900	6.100
2	57.900	53.200	6.200	4.900	6.200
3	57.950	53.200	5.900	4.900	6.000
4	57.900	53.200	6.000	4.900	5.900
5	57.900	53.200	6.000	4.900	6.100
6	57.950	53.200	5.900	4.900	6.100
7	57.900	53.250	6.000	4.900	6.100
8	57.900	53.200	6.000	4.900	6.100
9	57.900	53.250	6.100	5.000	6.100
10	57.875	53.200	6.100	4.900	5.900
11	57.800	53.200	6.000	4.900	5.900
12	57.900	53.250	6.000	5.000	6.000
13	57.875	53.200	6.000	4.900	6.000
14	57.900	53.200	6.000	4.900	5.900
15	57.875	53.200	6.000	4.900	6.000

TABLE XLVI

MEASUREMENTS OF DUPLICATE DENTURE NO. 11 (in mm)

AFTER 4 MONTHS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.100	53.350	5.780	5.000	6.000
2	58.100	53.300	5.780	5.000	6.000
3	58.100	53.300	5.700	5.000	6.000
4	58.100	53.300	5.780	5.000	6.000
5	58.100	53.300	5.700	5.000	6.000
6	58.050	53.300	5.700	5.000	6.000
7	58.100	53.300	5.700	5.000	6.000
8	58.100	53.300	5.780	4.940	6.000
9	58.100	53.350	5.700	5.000	6.000
10	58.100	53.350	5.700	5.000	6.000
11	58.100	53.300	5.780	5.000	6.000
12	58.100	53.300	5.780	5.000	6.100
13	58.100	53.300	5.780	5.000	6.000
14	58.100	53.300	5.780	5.000	6.000
15	58.100	53.300	5.780	5.000	6.000

TABLE XLVII

TWELFTH MEASUREMENTS OF MASTER DENTURE (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.775	53.900	5.760	4.900	6.100
2	58.800	53.900	5.760	4.900	6.000
3	58.800	53.900	5.760	5.000	6.000
4	58.750	53.900	5.760	5.000	6.000
5	58.775	53.900	5.760	4.960	6.000
6	58.725	53.900	5.760	5.100	6.000
7	58.700	53.900	5.760	5.000	6.000
8	58.700	53.900	5.760	5.000	6.000
9	58.700	53.900	5.760	4.980	6.000
10	58.700	53.900	5.760	5.160	6.000
11	58.700	53.900	5.760	4.980	6.000
12	58.750	53.900	5.780	4.940	6.000
13	58.800	53.900	5.780	5.000	6.100
14	58.700	53.900	5.780	5.000	6.000
15	58.700	53.900	5.780	5.000	6.000

TABLE XLVIII

MEASUREMENTS OF DUPLICATE DENTURE NO. 12 (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.000	53.100	6.000	4.760	6.000
2	58.050	53.100	6.000	4.760	6.000
3	58.025	53.100	6.000	4.760	6.000
4	58.025	53.100	5.900	4.820	6.000
5	58.025	53.100	5.900	4.720	6.000
6	58.025	53.100	5.900	4.700	6.000
7	58.000	53.100	5.900	4.700	6.000
8	58.050	53.125	5.880	4.760	6.000
9	58.000	53.100	5.900	4.760	5.980
10	58.050	53.100	5.900	4.760	5.900
11	58.050	53.100	5.900	4.760	6.000
12	58.050	53.125	6.000	4.720	5.900
13	58.050	53.100	6.000	4.700	5.900
14	58.100	53.100	5.900	4.760	5.900
15	58.050	53.100	5.900	4.760	5.900

TABLE XLIX

MEASUREMENTS OF DUPLICATE DENTURE NO. 12 (in mm)

AFTER 24 HOURS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.100	53.350	6.000	4.800	6.000
2	58.100	53.300	6.000	4.900	6.100
3	58.050	53.300	6.000	4.940	6.000
4	58.100	53.300	6.000	4.900	6.000
5	58.100	53.250	6.000	4.900	6.100
6	58.100	53.300	6.000	4.900	6.000
7	58.100	53.300	6.000	4.900	6.100
8	58.000	53.300	6.000	4.900	6.000
9	58.050	53.300	5.900	5.000	6.100
10	58.100	53.300	5.900	4.900	6.000
11	58.000	53.300	5.900	5.000	6.000
12	58.000	53.300	6.000	4.900	5.900
13	58.000	53.300	5.900	4.900	5.800
14	58.100	53.300	6.000	4.900	5.900
15	58.000	53.300	6.000	4.900	6.000

TABLE L

MEASUREMENTS OF DUPLICATE DENTURE NO. 12 (in mm)

AFTER 4 MONTHS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.300	53.400	5.900	5.000	6.100
2	58.300	53.400	5.900	5.000	6.000
3	58.300	53.375	5.840	4.800	6.000
4	58.325	53.400	5.840	4.750	6.000
5	58.300	53.400	5.900	4.750	6.000
6	58.300	53.375	5.700	4.800	6.000
7	58.300	53.375	5.900	4.800	6.000
8	58.300	53.400	5.900	4.800	6.000
9	58.300	53.400	5.840	4.800	6.000
10	58.300	53.400	5.840	4.800	6.000
11	58.300	53.350	5.860	4.800	6.000
12	58.300	53.350	5.840	4.800	6.000
13	58.325	53.350	5.860	4.800	6.000
14	58.300	53.350	5.900	4.750	6.000
15	58.300	53.400	5.900	4.750	6.000

TABLE LI

THIRTEENTH MEASUREMENTS OF MASTER DENTURE (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.800	53.900	5.740	4.960	6.100
2	58.750	53.875	5.700	4.960	6.000
3	58.750	53.900	5.760	4.980	6.000
4	58.750	53.900	5.700	5.000	6.000
5	58.750	53.900	5.700	4.980	6.000
6	58.750	53.875	5.720	5.000	6.140
7	58.750	53.900	5.760	5.000	6.100
8	58.775	53.900	5.760	4.980	6.100
9	58.700	53.900	5.760	5.000	6.100
10	58.750	53.900	5.700	5.000	6.000
11	58.750	53.875	5.700	5.000	6.000
12	58.800	53.900	5.700	5.000	6.140
13	58.750	53.900	5.760	5.000	6.000
14	58.750	53.900	5.760	5.100	6.000
15	58.700	53.900	5.760	4.960	6.000

TABLE LII

MEASUREMENTS OF DUPLICATE DENTURE NO. 13 (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.000	53.200	6.300	4.880	5.940
2	58.025	53.100	6.300	4.740	5.900
3	58.000	53.125	6.000	4.760	5.900
4	58.050	53.125	6.000	4.760	5.900
5	58.000	53.125	6.000	4.760	5.700
6	58.000	53.125	5.900	4.760	6.000
7	58.050	53.125	5.900	4.760	5.900
8	58.025	53.100	5.900	4.760	5.900
9	58.025	53.125	6.000	4.700	5.760
10	58.000	53.100	6.000	4.700	5.800
11	58.075	53.125	5.900	4.700	5.900
12	58.000	53.125	5.900	4.900	5.900
13	58.050	53.100	5.900	4.900	5.760
14	58.000	53.100	5.900	4.760	5.900
15	58.000	53.100	5.900	4.760	5.900

TABLE LIII

MEASUREMENTS OF DUPLICATE DENTURE NO. 13 (in mm)

AFTER 24 HOURS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.150	53.350	6.000	4.980	6.000
2	58.150	53.300	6.000	4.780	6.000
3	58.200	53.300	5.900	4.900	6.000
4	58.200	53.300	5.900	4.900	5.900
5	58.150	53.300	6.000	4.900	5.900
6	58.200	53.300	6.000	4.900	6.000
7	58.150	53.200	5.900	4.900	6.000
8	58.200	53.300	5.900	4.900	6.000
9	58.200	53.250	5.900	4.900	5.950
10	58.200	53.250	5.900	4.900	6.000
11	58.200	53.250	6.000	4.900	6.000
12	58.200	53.250	6.000	5.000	6.000
13	58.150	53.250	6.000	5.000	5.900
14	58.200	53.300	6.000	4.980	6.000
15	58.150	53.300	6.000	5.000	6.000

TABLE LIV

MEASUREMENTS OF DUPLICATE DENTURE NO. 13 (in mm)

AFTER 4 MONTHS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.250	53.350	5.900	5.000	6.000
2	58.250	53.400	5.900	5.000	6.000
3	58.250	53.350	5.980	5.000	6.000
4	58.225	53.350	6.000	5.000	6.000
5	58.225	53.350	5.900	5.000	6.000
6	58.250	53.350	5.900	5.000	6.000
7	58.250	53.350	5.960	5.000	5.980
8	58.250	53.350	5.900	5.000	5.980
9	58.225	53.350	5.900	5.000	6.000
10	58.250	53.400	5.900	5.000	6.000
11	58.250	53.400	5.900	5.000	6.000
12	58.250	53.350	5.900	5.000	6.000
13	58.250	53.400	5.900	5.000	6.000
14	58.250	53.400	5.900	5.000	6.000
15	58.250	53.400	5.900	5.000	6.000

TABLE LV

FOURTEENTH MEASUREMENTS OF MASTER DENTURE (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.900	53.900	5.760	4.980	6.000
2	58.900	53.900	5.760	4.960	6.000
3	58.900	53.900	5.700	5.000	6.100
4	58.875	53.900	5.760	4.980	6.100
5	58.900	53.875	5.780	4.960	6.000
6	58.900	53.900	5.760	4.980	6.000
7	58.900	53.900	5.700	5.000	6.000
8	58.875	53.900	5.760	4.960	6.140
9	58.800	53.900	5.760	5.000	6.000
10	58.800	53.875	5.780	5.000	6.120
11	58.900	53.900	5.760	5.000	6.000
12	58.850	53.900	5.760	5.000	6.000
13	58.800	53.900	5.760	5.000	6.000
14	58.850	53.900	5.760	4.960	6.000
15	58.825	53.900	5.760	5.000	6.000

TABLE LVI

MEASUREMENTS OF DUPLICATE DENTURE NO. 14 (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.100	53.300	6.000	5.000	6.000
2	58.100	53.300	6.300	4.980	6.000
3	58.100	53.275	6.000	4.980	6.000
4	58.050	53.275	6.000	4.980	6.000
5	58.050	53.300	6.300	4.980	6.000
6	58.050	53.300	6.300	5.000	6.000
7	58.100	53.225	6.400	5.000	6.000
8	58.100	53.300	6.000	5.000	6.000
9	58.100	53.275	6.300	5.000	6.000
10	58.100	53.275	6.000	5.000	6.000
11	58.100	53.275	6.000	4.980	6.000
12	58.100	53.200	6.000	4.980	6.000
13	58.100	53.300	6.000	4.980	6.000
14	58.100	53.300	6.000	4.980	6.000
15	58.100	53.300	6.000	5.000	6.000

TABLE LVII

MEASUREMENTS OF DUPLICATE DENTURE NO. 14 (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.100	53.250	6.000	5.000	6.000
2	58.200	53.200	6.000	4.900	6.000
3	58.200	53.250	6.000	5.000	6.100
4	58.200	53.250	6.000	4.950	6.100
5	58.100	53.200	6.000	4.950	5.900
6	58.150	53.200	6.000	5.000	5.900
7	58.150	53.300	5.900	5.000	6.100
8	58.200	53.250	5.900	4.900	6.100
9	58.200	53.250	6.000	5.000	6.000
10	58.150	53.300	6.000	4.950	6.100
11	58.150	53.250	6.100	4.950	6.000
12	58.200	53.250	6.000	4.950	6.000
13	58.200	53.300	6.000	4.900	5.950
14	58.200	53.300	6.100	5.000	6.000
15	58.150	53.300	6.000	5.000	5.950

TABLE LVIII

MEASUREMENTS OF DUPLICATE DENTURE NO. 14 (in mm)

AFTER 4 MONTHS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.200	53.425	6.000	5.000	6.100
2	58.200	53.400	6.000	5.000	6.000
3	58.200	53.400	6.000	5.000	6.000
4	58.200	53.400	6.000	5.000	6.000
5	58.200	53.400	6.000	5.000	6.000
6	58.200	53.400	6.000	5.000	6.000
7	58.200	53.400	6.000	5.000	6.000
8	58.200	53.400	6.000	5.000	6.100
9	58.200	53.400	6.000	5.000	6.100
10	58.150	53.400	6.000	5.000	6.000
11	58.200	53.425	6.000	5.000	6.000
12	58.200	53.425	6.000	5.000	6.000
13	58.200	53.450	6.000	5.000	6.000
14	58.200	53.450	6.000	5.000	6.000
15	58.200	53.475	6.000	5.000	6.000

TABLE LIX

FIFTEENTH MEASUREMENTS OF MASTER DENTURE (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.850	53.900	5.900	5.000	6.000
2	58.900	53.900	5.860	4.880	6.000
3	58.900	53.900	5.780	4.880	5.960
4	58.900	53.875	5.760	4.920	6.000
5	58.900	53.900	5.760	5.000	6.000
6	58.900	53.900	5.760	4.900	6.000
7	58.850	53.900	5.780	5.000	6.000
8	58.875	53.900	5.760	4.900	6.000
9	58.875	53.900	5.760	5.000	6.000
10	58.900	53.900	5.780	4.900	6.000
11	58.900	53.900	5.780	5.000	5.980
12	58.900	53.900	5.780	4.920	5.980
13	58.900	53.900	5.760	5.000	6.000
14	58.900	53.900	5.780	4.900	6.000
15	58.900	53.900	5.780	4.920	5.980

TABLE LX

MEASUREMENTS OF DUPLICATE DENTURE NO. 15 (in mm)

M#	BFW	BMW	VHM	VHB	VHI
1	58.225	53.250	6.500	4.860	6.000
2	58.250	53.225	6.500	5.000	6.000
3	58.300	53.225	6.500	5.000	6.000
4	58.250	53.200	6.500	4.900	6.000
5	58.250	53.200	6.500	5.000	6.000
6	58.150	53.225	6.500	5.000	6.000
7	58.150	53.225	6.500	4.860	6.000
8	58.150	53.200	6.500	4.860	6.000
9	58.200	53.200	6.500	4.780	6.000
10	58.150	53.200	6.500	4.780	6.000
11	58.150	53.200	6.500	5.000	6.000
12	58.150	53.250	6.500	4.880	6.000
13	58.150	53.250	6.500	4.880	6.000
14	58.150	53.250	6.500	5.000	6.000
15	58.150	53.250	6.500	5.000	6.000

TABLE LXI

MEASUREMENTS OF DUPLICATE DENTURE NO. 15 (in mm)

AFTER 24 HOURS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.250	53.300	6.400	5.000	6.100
2	58.250	53.300	6.500	4.900	6.000
3	58.250	53.300	6.500	5.000	6.000
4	58.150	53.300	6.500	5.000	6.000
5	58.300	53.200	6.500	4.950	6.000
6	58.300	53.200	6.500	4.900	6.000
7	58.200	53.250	6.500	4.950	6.000
8	58.200	53.250	6.500	5.000	6.000
9	58.200	53.250	6.500	5.000	6.000
10	58.200	53.200	6.500	5.000	5.980
11	58.200	53.250	6.500	4.860	6.100
12	58.200	53.250	6.500	4.900	6.000
13	58.200	53.250	6.500	4.950	6.000
14	58.250	53.250	6.500	4.860	6.000
15	58.250	53.300	6.500	4.900	6.000

TABLE LXII

MEASUREMENTS OF DUPLICATE DENTURE NO. 15 (in mm)

AFTER 4 MONTHS OF WATER IMMERSION

M#	BFW	BMW	VHM	VHB	VHI
1	58.375	53.400	6.500	4.980	6.100
2	58.400	53.375	6.500	4.980	6.100
3	58.375	53.400	6.500	5.000	6.100
4	58.400	53.375	6.520	5.000	6.000
5	58.350	53.400	6.520	5.000	6.000
6	58.350	53.400	6.520	4.980	6.000
7	58.400	53.400	6.500	4.980	6.000
8	58.400	53.400	6.500	5.000	6.000
9	58.375	53.375	6.500	5.000	6.000
10	58.375	53.375	6.500	5.000	6.000
11	58.400	53.400	6.500	4.980	6.000
12	58.375	53.400	6.500	4.980	6.000
13	58.400	53.375	6.500	4.980	6.000
14	58.400	53.375	6.520	5.000	6.100
15	58.375	53.400	6.520	5.000	6.000

TABLE LXIII

STATISTICAL RESULTS

BFW = Buccal Flange Width
BMW = Buccal Molar Width
VHM = Vertical Height Molar
VHB = Vertical Height Bicuspid
VHI = Vertical Height Incisor

DENTURE	STAT	BFW	BMW	VHM	VHB	VHI
D_1	$\overline{X}$	58.437	53.193	5.745	4.583	6.443
	σ	.0742	.0437	.1099	.0179	.0458
	d	- .327	- .714	-.018	-.465	.375
	%	-0.56	-1.32	-0.31	-9.21	6.18
	t	-12.63**	-58.33**	-0.62	-15.42**	11.74**
D_1-24	$\overline{X}$	58.498	53.455	5.767	4.541	6.186
	σ	.1066	.0635	.0270	.0266	.1425
	d	- .266	- .452	.004	-.507	.118
	%	-0.45	-0.84	0.07	-10.04	1.94
	t	-8.17**	-26.56**	0.40	-16.54**	2.50*
D_2	$\overline{X}$	58.117	53.275	5.794	4.982	6.762
	σ	.0692	.0422	.0679	.0077	.0006
	d	- .647	- .632	.031	-.066	.694
	%	-1.10	-1.17	0.54	-1.31	11.44
	t	-25.79**	-53.42**	1.63	-2.21*	23.40**
D_2-24	$\overline{X}$	58.113	53.570	5.829	4.705	6.220
	σ	.0524	.0510	.0891	.1016	.1233
	d	- .651	- .337	.066	-.343	.152
	%	-1.11	-0.62	1.14	-6.79	2.50
	t	-29.42**	-23.83**	2.74*	-8.63**	3.50**

TABLE LXIII cont'd

STATISTICAL RESULTS

DENTURE	STAT	BFW	BMW	VHM	VHB	VHI
D_3	$\overline{X}$	58.085	53.438	5.314	4.941	6.625
	σ	.0806	.2004	.1926	.0782	.3339
	d	- .679	- .469	-.449	-.107	.557
	%	-1.16	-0,87	-7.79	-2.12	9.18
	t	-24.96**	-9.03**	-8.95**	-2.97**	6.11**
D_3-24	$\overline{X}$	58.108	53.297	5.446	4.767	6.126
	σ	.0224	.0247	.1809	.0640	.0243
	d	- .656	- .610	-.317	-.281	.058
	%	-1.12	-1.13	-5.50	-5.57	0.95
	t	-35.59**	-72.97**	-6.71**	-8.25**	1.91
D_4	$\overline{X}$	58.280	53.293	5.984	4.520	6.133
	σ	.0669	.0593	.0620	.0620	.2821
	d	- .484	- .614	.221	- .528	.065
	%	-0.82	-1.14	3.83	-10.46	1.07
	t	-19.76**	-38.09**	12.76**	-15.57**	0.83
D_4-24	$\overline{X}$	58.202	53.247	6.137	4.547	5.993
	σ	.0197	.0126	.1050	.0723	.0493
	d	- .562	- .660	.374	-.501	-.075
	%	-0.95	-1.22	6.49	-9.92	-1.23
	t	-30.95**	-104.40**	13.40**	-14.23**	-2.33*

TABLE LXIII cont'd

STATISTICAL RESULTS

DENTURE	STAT	BFW	BMW	VHM	VHB	VHI
D_5	$\bar{X}$	58.195	53.293	5.783	5.008	6.074
	σ	.0568	.0197	.0658	.0933	.2098
	d	-.569	-.614	.020	-.040	.006
	%	-0.96	-1.13	0.35	-0.79	0.10
	t	-24.96··	-86.85··	1.09	-1.04	0.10
D_5-24	$\bar{X}$	58.122	53.303	5.931	4.632	5.907
	σ	.0297	.0126	.0636	.0716	.0958
	d	-.642	-.604	.168	-.416	-.161
	%	-1.09	-1.12	2.92	-8.24	-2.65
	t	-33.39··	-95.57··	9.40··	-11.86··	-4.17··
D_6	$\bar{X}$	58.137	53.272	5.848	4.757	5.944
	σ	.1977	.0387	.1123	.1173	.0718
	d	-.627	-.635	.085	-.291	-.124
	%	-1.06	-1.18	1.47	-5.76	-2.04
	t	-11.62··	-57.99··	2.85·	-6.84··	-3.55··
D_6-24	$\bar{X}$	58.005	53.413	5.873	4.788	5.941
	σ	.1405	.0949	.0750	.0961	.0509
	d	-.759	-.494	.110	-.260	-.127
	%	-1.29	-0.91	1.91	-5.15	-2.09
	t	-18.86··	-19.69··	5.37··	-6.69··	-3.92··

TABLE LXIII cont'd

STATISTICAL RESULTS

DENTURE	STAT	BFW	BMW	VHM	VHB	VHI
D_7	$\bar{X}$	57.957	53.002	6.093	5.000	6.123
	σ	.1489	.0063	.2270	.0806	.1654
	d	-.807	-.905	.330	-.048	.055
	%	-1.37	-1.68	5.73	-0.95	0.91
	t	-19.13¨	-165.45¨	5.59¨	-1.32	1.06
D_7-24	$\bar{X}$	58.342	53.223	6.053	5.047	5.997
	σ	.0572	.0305	.0516	.0743	.1195
	d	-.422	-.684	.290	-.001	-.071
	%	-0.72	-1.27	5.03	-0.02	-1.17
	t	-18.51¨	-72.15¨	19.13¨	-0.03	-1.66
D_8	$\bar{X}$	58.415	53.210	6.183	4.920	6.103
	σ	.0451	.0498	.1209	.0806	.1095
	d	-.349	-.697	.420	-.128	.035
	%	-0.59	-1.29	7.29	-2.54	0.58
	t	-16.64¨	-50.58¨	13.15¨	-3.52¨	0.85
D_8-24	$\bar{X}$	58.410	53.287	6.459	4.880	6.284
	σ	.0451	.0297	.1989	.0684	.1281
	d	-.354	-.620	.696	-.168	.216
	%	-0.60	-1.15	12.08	-3.33	3.56
	t	-16.88¨	-69.35¨	13.42¨	-4.85¨	4.87¨

TABLE LXIII cont'd

STATISTICAL RESULTS

DENTURE	STAT	BFW	BMW	VHM	VHB	VHI
D_9	$\bar{X}$	58.272	53.427	6.409	4.860	6.215
	σ	.0311	.0257	.1173	.0614	.1878
	d	- .492	- .480	.646	-.188	.147
	%	-0.83	-0.89	11.21	-3.72	2.42
	t	-25.59··	-57.42··	20.85··	-5.57··	2.59·
D_9-24	$\bar{X}$	58.385	53.468	6.500	5.133	6.207
	σ	.0226	.0305	.1091	.0488	.1848
	d	- .379	- .439	.737	.085	.139
	%	-0.64	-0.81	12.79	1.68	2.29
	t	-20.56··	-46.31··	25.43··	2.62·	2.48·
D_{10}	$\bar{X}$	57.902	53.283	6.008	4.979	6.112
	σ	.0522	.0672	.0310	.0366	.1285
	d	- .862	- .624	.245	-.069	.044
	%	-1.46	-1.16	4.25	-1.37	0.72
	t	-38.95··	-34.36··	23.38··	-2.20·	0.99
D_{10}-24	$\bar{X}$	57.937	53.407	6.148	4.900	6.243
	σ	.0247	.0416	.0909	.1195	.1397
	d	- .827	- .500	.385	-.148	.175
	%	-1.41	-0.93	6.68	-2.93	2.88
	t	-44.22··	-42.27··	15.72··	-3.45··	3.75··

TABLE LXIII cont'd

STATISTICAL RESULTS

DENTURE	STAT	BFW	BMW	VHM	VHB	VHI
D_{11}	$\bar{X}$	57.832	53.103	5.924	5.047	6.080
	σ	.0537	.0084	.0793	.2416	.0676
	d	-.932	-.804	.161	-.001	.012
	%	-1.58	-1.49	2.79	-0.02	0.20
	t	-41.68**	-146.98**	7.43**	-0.01	0.35
D_{11}-24	$\bar{X}$	57.892	53.210	6.013	4.913	6.027
	σ	.0361	.0205	.0743	.0351	.0961
	d	-.872	-.697	.250	-.135	-.041
	%	-1.48	-1.29	4.34	-2.67	-0.67
	t	-44.17**	-98.59**	12.20**	-4.34**	-1.06
D_{12}	$\bar{X}$	58.037	53.103	5.932	4.747	5.965
	σ	.0265	.0084	.0500	.0326	.0481
	d	-.727	-.804	.169	-.301	-.103
	%	-1.23	-1.49	2.93	-5.96	-1.70
	t	-38.88**	-146.98**	11.66**	-9.72**	-3.21**
D_{12}-24	$\bar{X}$	58.060	53.300	5.973	4.909	6.000
	σ	.0470	.0187	.0457	.0465	.0845
	d	-.704	-.607	.210	-.139	-.068
	%	-1.19	-1.13	3.64	-2.75	-1.12
	t	-33.19**	-85.86**	15.24**	-4.33**	-1.85

TABLE LXIII cont'd

STATISTICAL RESULTS

DENTURE	STAT	BFW	BMW	VHM	VHB	VHI
D_{13}	$\overline{X}$	58.020	53.120	5.987	4.773	5.871
	σ	.0253	.0253	.1356	.0666	.0792
	d	- .744	- .787	.224	-.275	-.197
	%	-1.26	-1.46	3.89	-5.45	-3.25
	t	-39.79**	-94.14**	6.29**	-7.97**	-5.46**
D_{13}-24	$\overline{X}$	58.180	53.280	5.960	4.923	5.973
	σ	.0253	.0367	.0507	.0594	.0457
	d	- .584	- .627	.197	-.125	-.095
	%	-0.99	-1.16	3.42	-2.48	-1.56
	t	-31.23**	-59.83**	13.28**	-3.72**	-2.98**
D_{14}	$\overline{X}$	58.087	53.280	6.107	4.989	6.000
	σ	.0228	.0300	.1580	.0100	.1344
	d	- .677	- .626	.344	-.059	-.068
	%	-1.15	-1.16	5.97	-1.17	-1.12
	t	-36.73**	-66.14**	8.32**	-1.97	-1.49
D_{14}-24	$\overline{X}$	58.170	53.257	6.000	4.963	6.013
	σ	.0367	.0371	.0534	.0399	.0718
	d	- .594	- .650	.237	-.085	-.055
	%	-1.01	-1.21	4.11	-1.68	-0.91
	t	-29.70**	-59.36**	15.30**	-2.69*	-1.58

TABLE LXIII cont'd

STATISTICAL RESULTS

DENTURE	STAT	BFW	BMW	VHM	VHB	VHI
D_{15}	$\overline{X}$	58.188	53.223	6.500	4.920	6.00
	σ	.0524	.0219	.1091	.0838	.1344
	d	- .576	- .684	.737	-.128	-.068
	%	-0.98	-1.27	12.79	-2.54	-1.12
	t	-26.03··	-88.37··	25.43··	-3.47··	-1.49
D_{15}-24	$\overline{X}$	58.227	53.257	6.493	4.945	6.012
	σ	.0416	.0371	.0257	.0539	.0361
	d	- .537	- .650	.730	-.103	-.056
	%	-0.91	-1.21	12.67	-2.04	-0.92
	t	-26.21	-59.36	77.00	-3.13	-1.81
MASTER	$\overline{X}$	58.764	53.907	5.763	5.048	6.068
	σ	.0684	.0213	.0282	.1159	.1151

· $t\ (.05) \geq 2.145$

·· $t\ (.01) \geq 2.977$

TABLE LXIV

STATISTICAL RESULTS

DENTURE	STAT	BFW	BMW	VHM	VHB	VHI
D_1-4mos	$\overline{X}$	58.600	53.567	5.715	4.620	6.096
	σ	.0189	.0515	.0366	.0410	.0497
	d	-0.164	-0.340	-0.048	-0.428	0.028
	%	-0.28	-0.63	-0.83	-8.48	0.46
	t	-8.97··	-23.69··	-4.03··	-13.49··	0.87
D_2-4mos	$\overline{X}$	58.310	53.667	5.697	4.933	6.103
	σ	.0338	.0362	.0103	.0522	.0453
	d	-0.454	-0.240	-0.066	-0.115	0.035
	%	-0.77	-0.45	-1.15	-2.28	0.58
	t	-23.08··	-22.19··	-8.52··	-3.51··	1.10
D_3-4mos	$\overline{X}$	58.272	53.632	5.508	4.972	5.989
	σ	.0281	.0504	.0166	.0343	.0103
	d	-0.492	-0.275	-0.255	-0.076	-0.079
	%	-0.84	-0.51	-4.42	-1.51	-1.30
	t	-25.82··	-19.50··	-30.26··	-2.44·	-2.65·
D_4-4mos	$\overline{X}$	58.360	53.367	6.284	4.488	6.020
	σ	.0324	.0244	.0264	.0248	.0414
	d	-0.404	-0.540	0.521	-0.560	-0.048
	%	-0.69	-1.00	9.04	-11.09	-0.79
	t	-20.73··	-65.01··	52.37··	-18.30··	-1.52

TABLE LXIV cont'd

STATISTICAL RESULTS

DENTURE	STAT	BFW	BMW	VHM	VHB	VHI
D_5-4mos	$\bar{X}$	58.305	53.553	5.920	4.807	5.816
	σ	.0194	.0129	.0321	.0162	.0340
	d	-0.459	-0.354	0.157	-0.241	-0.252
	%	-0.78	-0.66	2.72	-4.77	-4.15
	t	-25.04··	-55.29··	14.27··	-7.98··	-8.13··
D_6-4mos	$\bar{X}$	58.307	53.605	5.569	5.012	5.933
	σ	.0114	.0103	.0361	.0361	.0488
	d	-0.457	-0.302	-0.194	-0.036	-0.135
	%	-0.78	-0.56	-3.37	-0.71	-2.22
	t	-25.59··	-49.65··	-16.46··	-1.15	-4.18··
D_7-4mos	$\bar{X}$	58.450	53.422	6.000	5.053	5.993
	σ	.0260	.0281	.0322	.0516	.0097
	d	-0.314	-0.485	0.237	0.005	-0.075
	%	-0.53	-0.90	4.11	0.10	-1.24
	t	-16.64··	-53.56··	21.46··	0.15	-2.52•
D_8-4mos	$\bar{X}$	58.633	53.457	6.272	4.989	6.100
	σ	.0450	.0199	.0230	.0183	.0391
	d	-0.131	-0.450	0.509	-0.059	0.032
	%	-0.22	-0.83	8.83	-1.17	0.53
	t	-6.20··	-60.14··	54.26··	-1.95	1.02

TABLE LXIV cont'd

STATISTICAL RESULTS

DENTURE	STAT	BFW	BMW	VHM	VHB	VHI
D_9-4mos	$\overline{X}$	58.517	53.583	6.423	5.093	5.992
	σ	.0244	.0323	.0392	.0258	.0748
	d	-0.247	-0.324	0.660	0.045	-0.076
	%	-0.42	-0.60	11.45	0.89	-1.25
	t	-13.20··	-32.57··	53.02··	1.47	-2.14·
D_{10}-4mos	$\overline{X}$	58.032	53.495	6.100	5.337	6.107
	σ	.0467	.0103	.0322	.0618	.0258
	d	-0.732	-0.412	0.337	0.289	0.039
	%	-1.25	-0.76	5.85	5.72	0.64
	t	-34.28··	-67.74··	30.51··	8.53··	1.28
D_{11}-4mos	$\overline{X}$	58.097	53.310	5.748	4.996	6.007
	σ	.0129	.0207	.0406	.0155	.0258
	d	-0.667	-0.597	-0.015	-0.052	-0.061
	%	-1.13	-1.11	-0.26	-1.03	-1.01
	t	-37.17··	-78.40··	-1.18	-1.72	-2.00
D_{12}-4mos	$\overline{X}$	58.303	53.382	5.861	4.813	6.007
	σ	.0088	.0221	.0526	.0790	.0258
	d	-0.461	-0.525	0.098	-0.235	-0.061
	%	-0.78	-0.97	1.70	-4.66	-1.01
	t	-25.93··	-66.68··	6.37··	-6.49··	-2.00

TABLE LXIV cont'd

STATISTICAL RESULTS

DENTURE	STAT	BFW	BMW	VHM	VHB	VHI
D_{13}-4mos	$\overline{X}$	58.245	53.370	5.916	5.000	5.997
	σ	.0103	.0253	.0340	.0410	.0070
	d	-0.519	-0.537	0.153	-0.048	-0.071
	%	-0.88	-1.00	2.65	-0.95	-1.17
	t	-29.10··	-63.29··	13.42··	-1.51	-2.39·
D_{14}-4mos	$\overline{X}$	58.197	53.417	6.000	5.000	6.020
	σ	.0129	.0244	.0322	.0410	.0414
	d	-0.567	-0.490	0.237	-0.048	-0.048
	%	-0.96	-0.91	4.11	-0.95	-0.79
	t	-31.50··	-58.99··	21.46··	-1.51	-1.52
D_{15}-4mos	$\overline{X}$	58.383	53.390	6.507	4.991	6.027
	σ	.0181	.0126	.0097	.0103	.0458
	d	-0.381	-0.517	0.744	-0.057	-0.041
	%	-0.65	-0.96	12.91	-1.13	-0.68
	t	-20.91··	-81.75··	96.86··	-1.90	-1.28
General Mean	$\overline{X}$	58.334	53.481	5.968	4.940	6.014
General	σ	0.1671	0.1123	0.3026	0.1992	0.0749

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